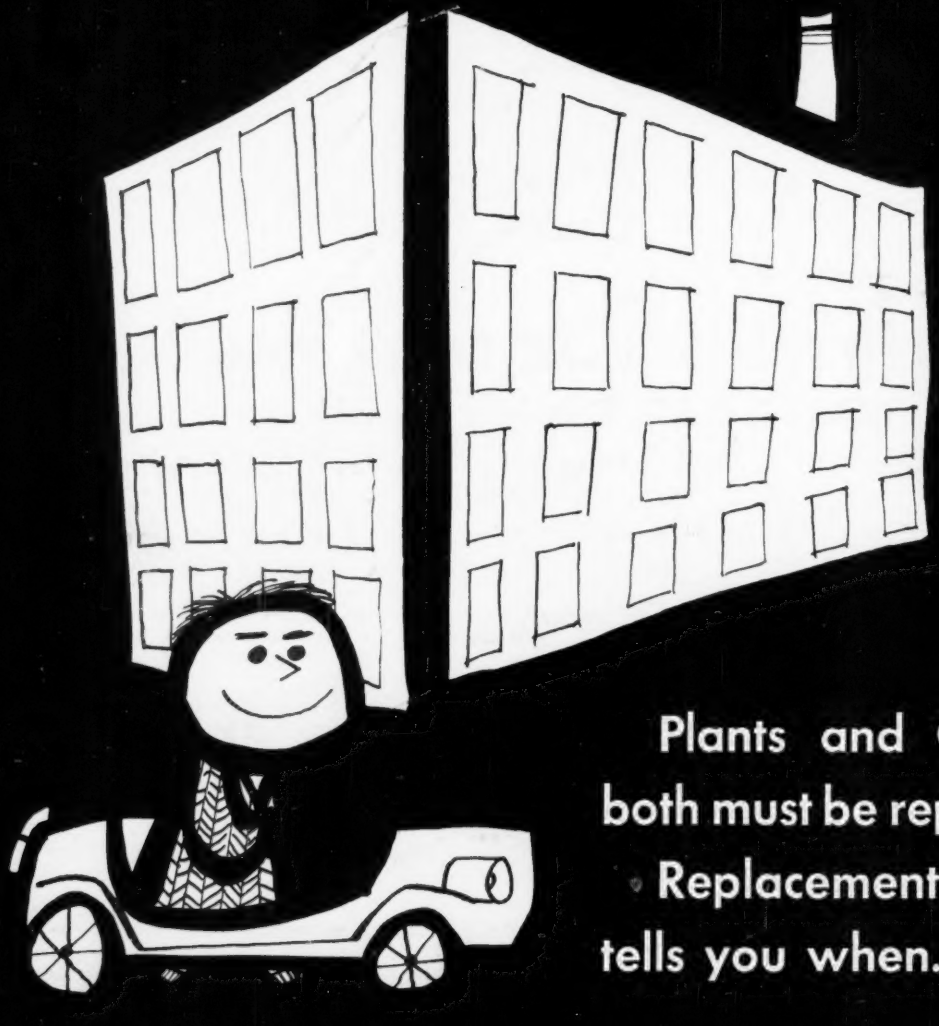
Are You Ready for
REGISTRATION
Page 214

Chemical Engineering

AUGUST 1955



Plants and Cars — both must be replaced. Replacement theory tells you when. p. 181

A McGRAW-HILL PUBLICATION

ONE DOLLAR

NEW STRENGTH FOR NEW ENGLAND

...as GIRDLER designs and builds

Anhydrous Ammonia Plant for Northern Chemical Industries, Inc.

NEW ENGLAND agriculture and industry will soon have its first local source of anhydrous ammonia, in the new Searsport, Maine, plant of Northern Chemical Industries, Inc., an affiliate of The Summers Fertilizer Company, Inc. The new plant is being engineered by Girdler to use *low-grade oil* as a raw material . . . the first such plant in the United States to do so.

The Girdler-built plant will produce 125 tons per day of anhydrous ammonia, a portion of which will be used to produce nitric acid and nitrogen solutions. The anhydrous ammonia and nitrogen solutions will be used for direct soil application and in mixed fertilizers. A part of the anhydrous ammonia will be marketed for industrial use.

Girdler has broad experience in designing and building plants to produce ammonia, ammonium nitrate, and other agricultural chemicals . . . and in construction of high-temperature, high-pressure process plants. For more information on this and the many other types of plants listed below call the nearest Girdler office today.

The GIRDLER Company

A DIVISION OF NATIONAL CYLINDER GAS COMPANY

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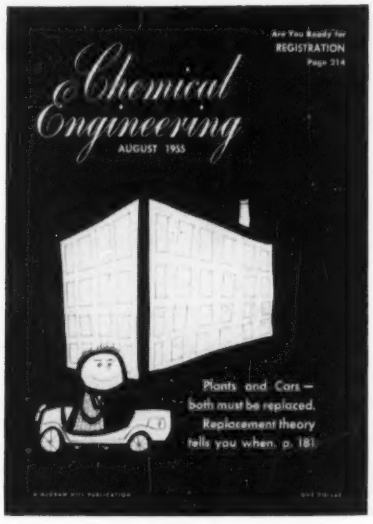
GUIDED TOUR

JOHN R. CALLAHAM, EDITOR


Are You Ready for REGISTRATION
Page 214
Chemical Engineering
AUGUST 1955
Plants and Cars—both must be replaced. Replacement theory tells you when. p. 181

Find More in Less Time

Ever had any trouble finding a story in CE you've already seen but want to refer to again?

If so, you've probably noticed that during the past 18 months we've made your job much easier.

Our regular contents pages, for one thing, now list all feature stories of every department. Nor do you have to thumb and fumble for CE's contents section. Every month, issue after issue, you'll find it in the same spot right inside the front cover.

In addition, here're the other "index services" you'll find in this issue—and every issue—of CE:

News features	p. 112
New chemicals	144
New equipment	238
Back-of-book departments	262
Reader Service	387
Chemicals & equipment	388
Technical literature	398
Advertisers	424
"PS" summary	Inside back cover

Use these indexes regularly to help you find things faster. —JRC

How you can solve your replacement problems by using capitalized costs.

You can expect more thorny problems in the economics of replacement as technology's pace speeds up. When's the best time to replace your equipment, process or plant? What will be the payout time? Is overhaul worth it? Should you wait for a better model? You can now get dollars-and-cents answers to such questions by using the "capitalized cost" technique. Allied's Fred Jelen shows how. (p. 181)

Design more effective experiments.

Use the statistical approach to cut down on the number of runs, increase accuracy, save time. This article tells how to use statistics in planning, conducting and interpreting complex experiments. (p. 191)

What about solids concentration?

Look for more emphasis on concentration techniques as raw materials become leaner. This critical survey of the entire

Please turn page

GUIDED TOUR

field is a sequel to our June report on solids-liquid separation. (p. 163)

More data on pump costs.

At last we're able to give you accurate and detail figures on the costs of installing centrifugal pumps. You'll find the data from Dow's engineers useful in your own cost estimating work. (p. 189)

Larger unit loads can save money . . .

. . . and plenty of it, too. Here Chemico's Allen Strong gets down to cases and pinpoints the pennies. He shows how to approach the problem, considers unit loads from pallets to barges! (p. 178)

Registration: Are you ready?

You are if you can prove you've got the required knowledge and experience—that's the rub. Turn to this month's You & Your Job for a clearer picture of what's needed and how to get it. (p. 214)

Rejoin GUIDED TOUR page 262

Chemical Engineering

AUGUST 1955

CHEMENTATOR 103

WHAT'S HAPPENING IN CHEMICAL ENGINEERING

Bio-Oxidation of Kraft Mill Wastes 112
Tower Design for Extractive Distillation 116
Progress in Synthetic Liquid Fuels 120
Heat of Reaction Cuts Process Costs 124
Employing Electronic Control 128
New Use for Nuclear Energy 132

CHEMICALS & RAW MATERIALS

New Fatty Alcohol Blends 140
Index to this month's new chemicals 144

FEATURE REPORT

Solids Concentration 163
N. Arbiter

FEATURE ARTICLES

Economics of Shipping in Larger Unit Loads . . . 178
A. K. Strong
Replacement Analysis by Capitalized Costs 181
F. C. Jelen
Cost of Installing Centrifugal Pumps 189
R. W. Lundeen and W. G. Clark
How to Design Effective Experiments 191
F. Proschan and A. B. Babcock, Jr.

CE REFRESHER

Why Kinetics for Reactor Design? 199
T. E. Corrigan and E. F. Young

PLANT NOTEBOOK

Sampler for Gases at High Pressure 202
E. R. Hawley and Ernest Solomon

Chart Finds Air-Film Coefficients 204
J. O. Osburn

Welding Repair to Process Vessel 206
Donald H. Lawrence

Boiling Out Stills 208
Marvin B. Schaffer

Compression-Expansion Chart for Gases 208
Antonio Di Lorenzo

Measuring Flows by Method of Mixtures 210
Thomas Garcia B.

YOU AND YOUR JOB

Are You Ready for Professional Registration? .. 214

Engineer Shortage: True or False? 222

CORROSION FORUM

Needed Painting Specifications Now Available .. 226

New Process Produces Crack-Free Chromium .. 230

EQUIPMENT NEWS

Improves Gas-Liquid Contact 234

Index to this month's new equipment 238

Floating Screen Traps Vapor 240

Equipment Cost Index 246

CHEMICAL ECONOMICS

For Chemicals: More Record Years Ahead 254

Optimism Lights Paper 258
Calvin S. Cronan

PICTURED FLOWSHEET

Fluidized Bed in Sulfuric Acid Plant 288

OTHER DEPARTMENTS

Advertisers Index 424

Book Reviews 306

Convention Calendar 118

Firms in the News 314

Man of the Month 295

Names in the News 296

New Technical Literature 398

Reader Service 387

Recent Pamphlets 310

CHEMICAL ENGINEERING

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To keep pace with the chemical, petrochemical and chemical process industries, more engineers subscribe to Chemical Engineering than to any other publication. Total net paid circulation of this issue:

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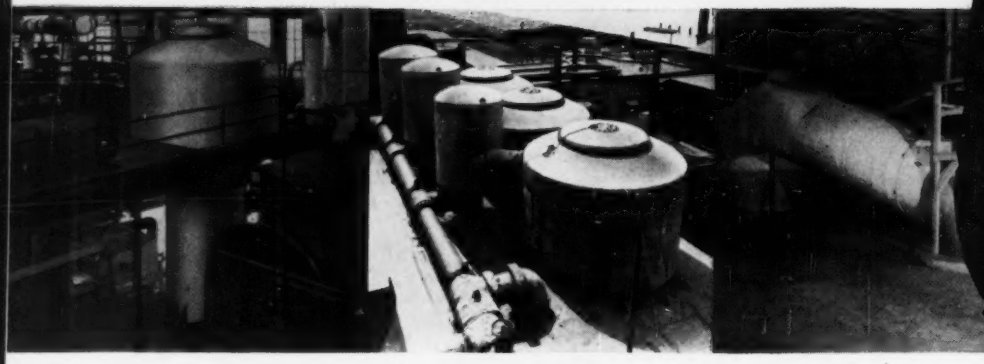
"But ..."

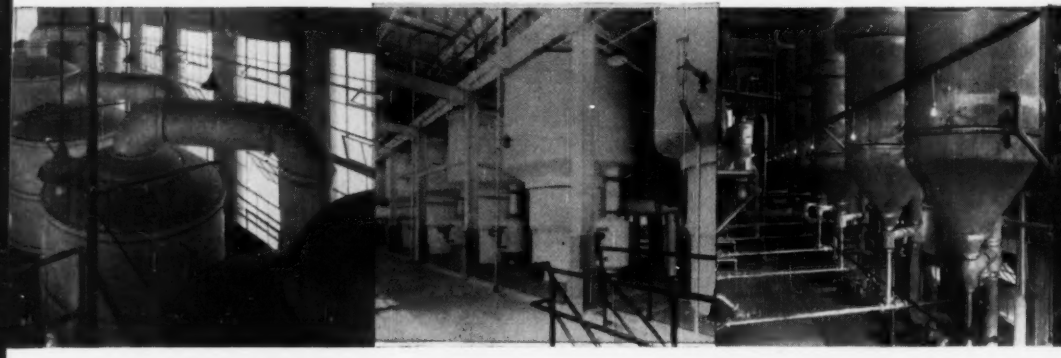


Long-tube, First-effect Pressure Evaporator operating on sugar juice, converting existing quadruple-effect to quintuple-effect.

Swenson Multiple-body, Quintuple-effect, Long-tube, vertical evaporator in a kraft paper mill.

A Swenson Spray Dryer used in a Distillery, handling distillers' solubles.

Every Spray Drying and Evaporating



Swenson Forced Circulation Evaporators used for concentration of viscous, salting and scaling liquors.

Swenson Quintuple-effect Evaporator used in the processing of beet sugar.

World's largest black liquor evaporator installation—a multiple-effect with more than a half-million pounds of evaporation per hour.

Engineering and Experience are called

Write Today for Information!

Get the complete Swenson Catalog . . . contains full information on long-tube vertical evaporator, spray dryers, crystallizers, forced circulation evaporators and recovery equipment for pulp mills such as pulp washers, black liquor evaporators, filters, and blow condensers.

.... my problem is different !"

Sure, your problem is different! That's the way it is with evaporation and spray drying. Nobody knows *that* better than Swenson Engineers, for every day they are helping to solve problems for firms who process every conceivable type of chemical or food. For more than 60 years, Swenson has been the symbol of experience and research in new evaporating and spray drying techniques. Swenson engineering has made possible lower production costs and the development of new products for new markets. The plant-scale research laboratories at Swenson are at your service to evaluate the potential of your product. Talk over your *different* problem with a Swenson engineer now —the collective experience that he has at his fingertips will help you answer it *correctly!*

SWENSON EVAPORATOR COMPANY
15669 Lathrop Avenue, Harvey, Illinois

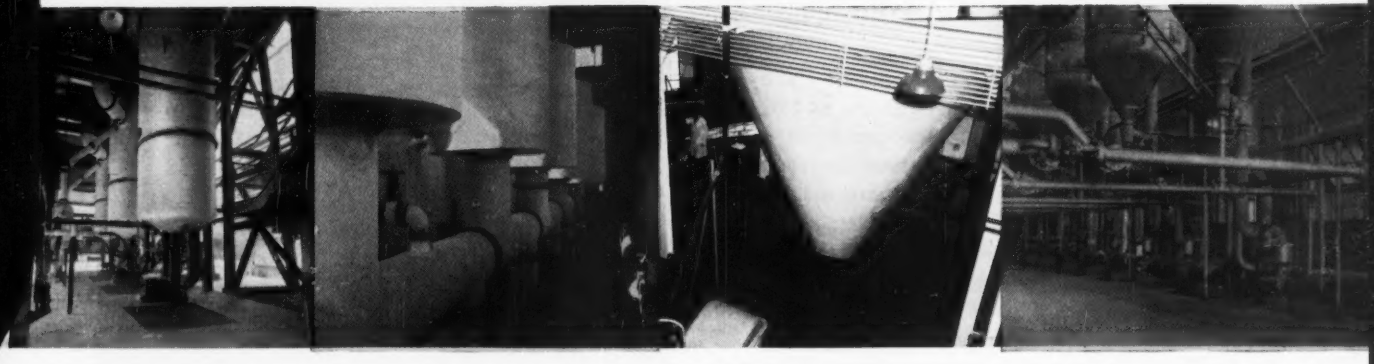
A Swenson Spray Dryer in operation at a large whole milk drying plant.

A gas-heated Swenson Spray Dryer in operation at a chemical processing plant.

Swenson also engineers washers for the pulp industry . . . shown is a single-drum, two-stage washer.

A Swenson Spray Dryer installation used in the production of starch products.

problem is different! That is why...Swenson



Swenson Multiple-effect, Long tube, Vertical Evaporator handling black liquor in a paper mill.

Catchalls and cutout vapor piping for a large Swenson Long-tube, Vertical Evaporator installation.

Lower section of Spray Dryer Chamber in which distillers' dried solubles are produced.

Swenson Multiple-effect, Quintuple-effect, Long-tube, Vertical Evaporator used for kraft mill black liquor.

upon by Industries everywhere. Remember ...

SWENSON

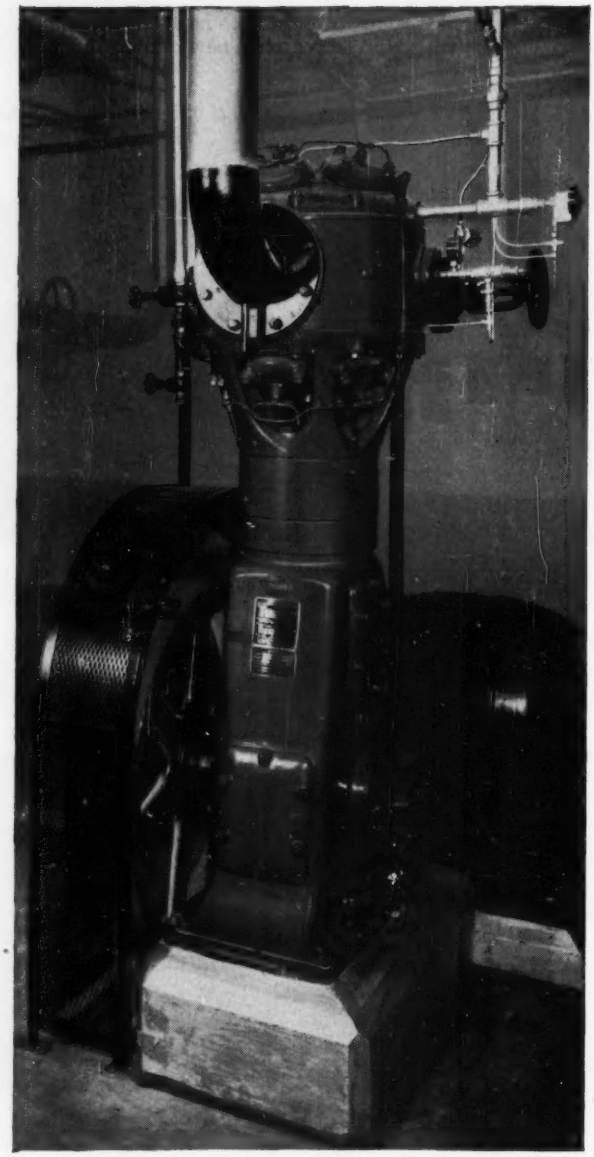
Proved Engineering for the Process Industries

Since 1889

A Division of WHITING Corporation

OIL-FREE AIR?

You'll be three steps ahead with the JOY WGO-9 COMPRESSOR



1 **VERTICAL DESIGN**—Saves floor space, allows simple installation. Prevents uneven wear in carbon rings. Eliminates necessity for periodic turning of piston to equalize ring wear.

2 **LONG-ROD CONSTRUCTION**—Spacer between crankcase and cylinder absolutely prevents passage of oil into cylinder. No part of the piston rod that enters the crankcase can enter the cylinder. No possibility of air contamination.

3 **SECTIONALIZED CARBON RINGS**—Expanders maintain ring-contact with cylinder wall despite wear. Rings last longer.

The Joy WGO-9 "long-rod" compressor is the result of more than twenty years' experience in the design and manufacture of non-lubricated compressors. In addition to the carbon graphite piston rings that need no lubrication, the Joy WGO-9 features special lightweight pistons; large, direct air passages; and liberal waterjacketing to reduce heat and minimize ring wear.

The patented Dual-Cushion Valves are made of corrosion-resistant materials. In addition, all metallic wearing surfaces are either chrome-plated, surface-hardened, or made of stainless steel.

Free Bulletin A-44 gives details on the Joy WGO-9 Oil-Free Compressor. Write for your copy TODAY to ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Limited, Galt, Ontario.*

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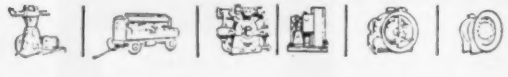
VACUUM PUMPS AND BOOSTERS



JOY W&D 1-5589

SPECIALISTS IN THE COMPRESSION AND MOVEMENT OF AIR AND GASES SINCE 1885

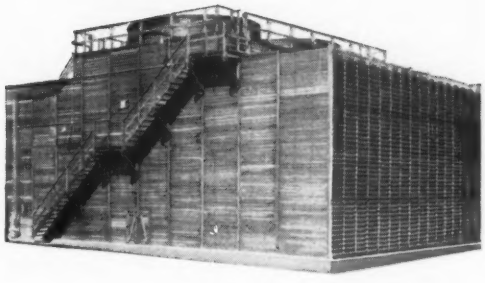
NOW

is the time to TEST Your Tower!

IF a water cooling tower has been installed in your plant in the past year, now is the time to find out whether the tower you own is the one you specified and paid for. This is the ideal time for a PERFORMANCE TEST. Your tower now should be operating at peak efficiency with all elements well co-ordinated. Of greater importance, ***this is the season when actual operating conditions most closely parallel conditions specified in your purchase contract.***

During summer months tower tests may be conducted at or near specified wet bulb temperatures, which means fewer variables, fewer calculations . . . it means the most accurate tests possible to obtain.

Since analysis of the results of a series of carefully conducted tests is the only method



of arriving at proof of the performance your tower is delivering, the manufacturer will be glad to assist in verifying the integrity of his product. He will welcome the opportunity to provide the necessary technical assistance that will enable you to conduct conclusive tests.

If you are not one of the 5000 engineers, operators and owners who requested copies of "Test Your Tower," the Marley brochure that explains a simple direct method of testing cooling towers, write for a copy today.

MARLEY®

The Marley Company

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MADE BY SPECIALISTS in *Stainless Steels, Monel, Nickel, Aluminum*

The FLOWLINE TRADE MARK Elbow

FLOWLINE Fittings are made by specialists having more experience with corrosion-resistant piping than any other fitting manufacturer. Our exclusive process of cold forming and annealing produces fittings in the best condition for corrosion service. The use of FLOWLINE Fittings makes available to users of corrosion-resistant piping the efficiency and economy of simplified welded construction.

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FLOWLINE Welding Fittings—tees, ells, reducers, stub ends, and caps—are made and normally stocked in Schedules 5S, 10S, 40S, and 80S—sizes ½" through 12"—in stainless types 304, 304L, 316, 347; Monel, Nickel, Aluminum. All fittings are annealed, cleaned bright—stainless fittings are passivated—and marked with type of metal, heat number, size, schedule, and wall thickness.

WELDING FITTINGS CORP.
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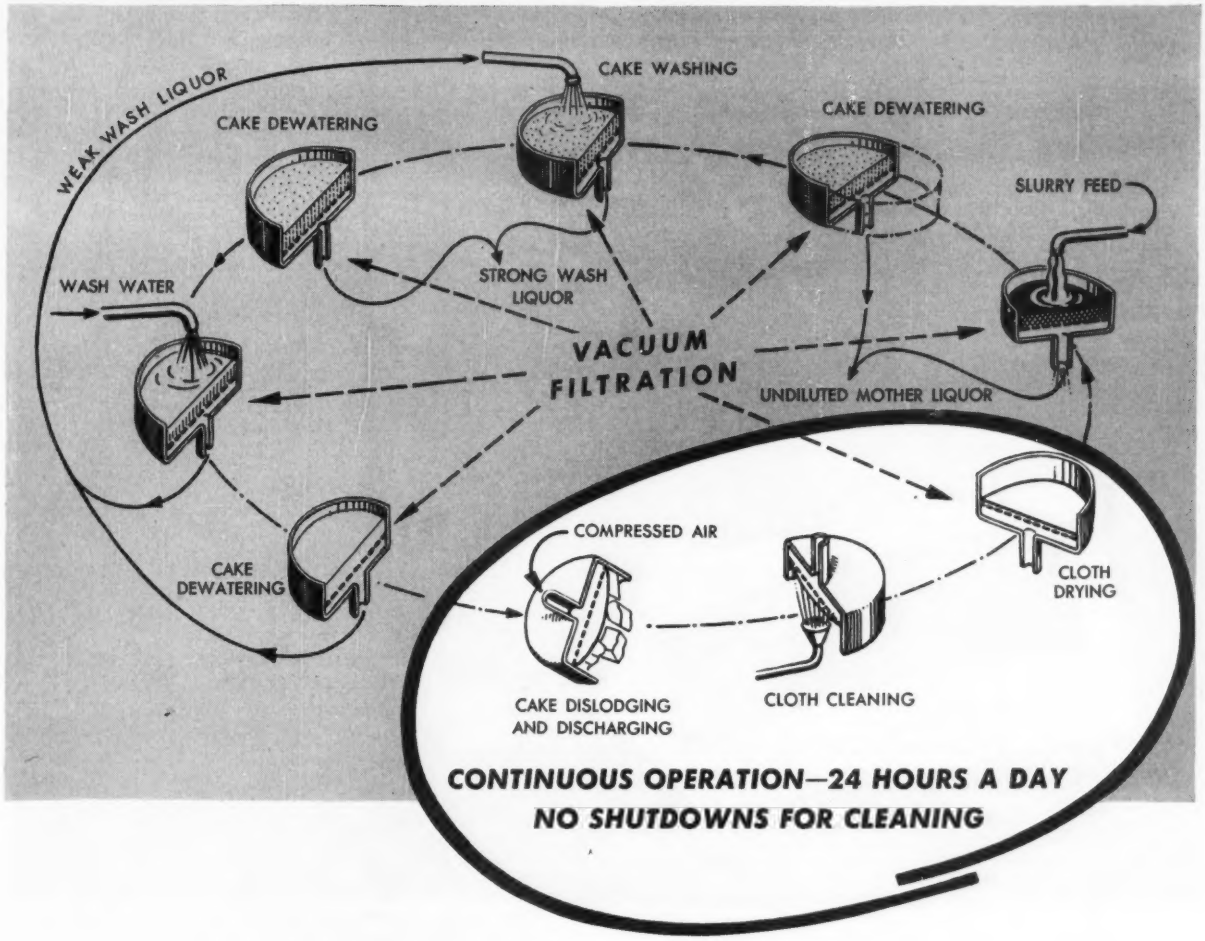
World's Largest Manufacturer of Stainless Welding Fittings

W-11

This Sketch Brings Out One Of The Many Advantages Of

The BIRD-PRAYON CONTINUOUS ROTARY HORIZONTAL VACUUM FILTER



As you can see, pneumatic dislodgment of the cake and 180° tray inversion, followed by pressure jet scouring of the cloth, assures complete, automatic cake discharge. There is no residual heel left on the cloth to lessen the efficiency of the filtration cycle. The cloth is dried and the tray is drained, so there's no dilution of mother liquor next time around.

Minimum wash water is another feature of the Bird-Prayon Filter. As many as five stages of counter-current wash are permitted. Solubles in the cake get down to an irreducible minimum.

Corrosive materials may be handled with the least amount of maintenance.

Whether your job involves quick-settling solids or the kind of slurries that tend to blind filter cloths, you'll find the Bird-Prayon Filter does it better and at less cost.

Ask us to mail you a copy of the new Bulletin on the Bird-Prayon Filter and show you how easy it is to obtain pilot-scale test data.

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SOUTH WALPOLE • MASSACHUSETTS
REGIONAL OFFICES: EVANSTON, ILLINOIS • PORTLAND, OREGON

Another new development using

B. F. Goodrich Chemical *raw materials*

Sealtite Conduit made by The American Brass Company, American Metal Hose Division, Waterbury 20, Conn.

Geon takes sting out of salt problem

WHEREVER salt is mined or processed, you have the problem of preventing corrosion. It's toughest where moisture is present, as in the salt conveyor installation above. That's where Geon polyvinyl material enters the picture, as a protective sheathing on the electrical conduit.

The Geon-jacketed conduit is salt-proof, sun-proof, oil-proof, and moisture-proof, resists abrasion, vibration, and extremes of temperature. Aptly named "Sealtite", it is the first flexible, liquid-tight conduit to receive Underwriters' approval.

Geon resins are basic materials throughout the electrical industry, not only for tough exterior jacketing, but for primary insulation as well. Geon contributes high dielectric strength, resistance to aging, and outstanding flex life—can be submerged in water or buried underground for years without degradation of properties.

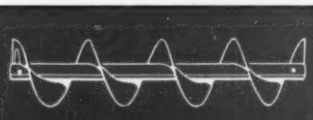
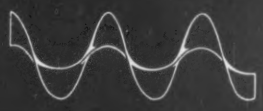
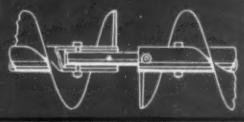
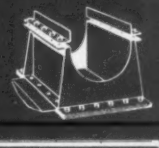
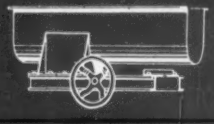
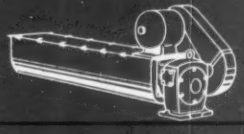
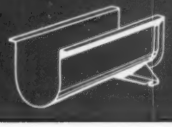
Geon polyvinyl materials upgrade the physical and electrical characteristics of many products, step up their sales appeal. There's an easy way to learn how Geon can benefit your own operations. Please write Dept. BB-8, B. F. Goodrich Chemical Company, Rose Building, Cleveland 15, Ohio. Cable address: Goodchemco. In Canada: Kitchener, Ontario.

GEON RESINS • GOOD-RITE PLASTICIZERS . . . the ideal team to make products easier, better and more saleable.

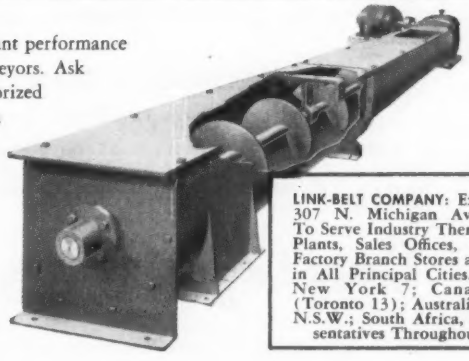
GEON polyvinyl materials • HYCAR American rubber and latex • GOOD-RITE chemicals and plasticizers • HARMON colors

When you buy screw conveyors... rate them against this quality chart

Only LINK-BELT gives you all these performance extras

ACCURATELY FORMED FLIGHTING		Link-Belt's specialized machinery assures accurate forming, producing uniformity of flighting curvature.
UNIFORM DIAMETERS		Only specially selected steels are used to meet Link-Belt's rigid specifications.
WIDE RANGE OF HANGERS		Hangers are available in a wide range of styles and mountings with various bearing materials.
EASY ASSEMBLY		Straightness is checked before shipping, and extra care is taken in handling and loading. Jig-drilled coupling bolt holes facilitate assembly.
ON-THE-JOB DISCHARGE OPENING LOCATION		For versatility in locating discharge openings, Link-Belt offers spouts and gates that can be easily installed on the job and bolted or welded in place.
CHOICE OF SPOUTS, GATES		Wide range of fixed or detachable plain discharge spouts or gates. Flat or curved slide type gates can be hand or rack-and-pinion operated.
FULLY INTEGRATED DRIVES		Only Link-Belt builds a complete, pre-integrated line of gear and chain drives, couplings, bearings. One proved source . . . one undivided responsibility.
ACCURATELY FABRICATED TROUGHS		Added refinements of manufacture assure better fit of all components. And Link-Belt offers you a choice of metals to fit your particular application.

These are only a few of the many important performance extras you get with Link-Belt screw conveyors. Ask your Link-Belt representative or authorized stock carrying distributor for 92-page Data Book 2289.

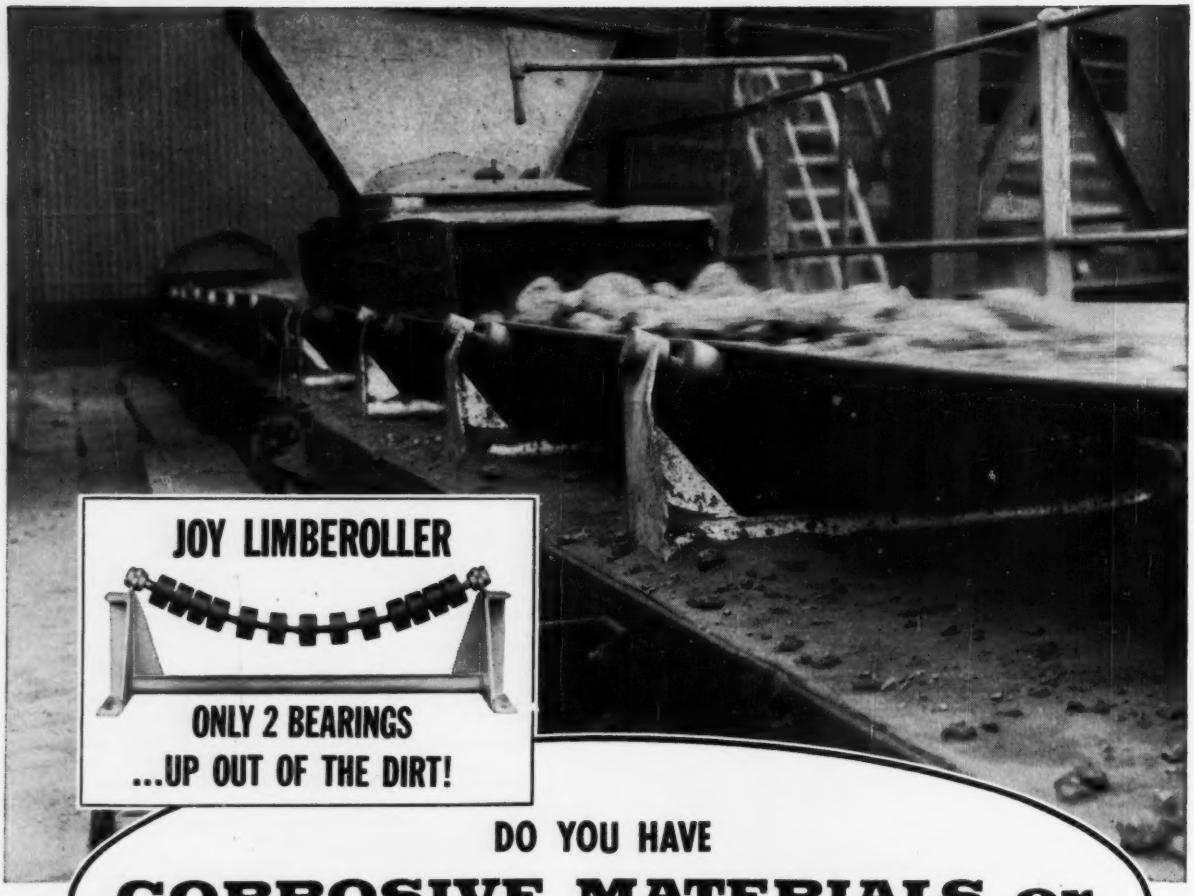


LINK-BELT

13,877

SCREW CONVEYORS

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants, Sales Offices, Stock Carrying Factory Branch Stores and Distributors in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World.



DO YOU HAVE
CORROSIVE MATERIALS or ATMOSPHERES
THAT *EAT UP* YOUR CONVEYOR IDLERS?

The Joy Limberoller idler consists of neoprene discs molded on neoprene-covered flexible steel cable. It is suspended from two bearings, one on each end, *out of the dirt zone.* This distinctive design, field-proved by thousands of idlers already in service, averts fouled idler rolls—protects the belt from damage—reduces your maintenance to a fraction—*gives many times longer service life on dusty, gritty or corrosive jobs.*

OTHER ADVANTAGES, TOO . . . Joy idlers are self-training—they conform to the load with a cushioned grip which supports the loaded belt without slipping and reduces belt wear. They resist corrosion, abrasion, flame and grease—weigh ⅔ less than steel idlers, and handle bulk or packaged materials equally well. They're easily changed *without stopping the belt,* and compactly stored.

Whatever your belt conveyor job may be, let us help you to make it more efficient and economical. Joy Limberoller Idlers are available for belt widths of 18″, 24″, 30″ and 36″. You'll find them easier, faster and less costly to install, maintain, knock down and move than any other conveyor idler on the market. ● For more information, write ***Joy Manufacturing Company, Oliver Building, Pittsburgh 22, Pa.*** In Canada: *Joy Manufacturing Company (Canada) Ltd., Galt, Ont.*

WRITE FOR COMPLETE DETAILS

Ask for free *Bulletin LD-103E.*

It gives complete information on the unique Limberoller Idler, and we'll be glad to supplement it with engineering assistance on your particular problem.

Consult a Joy Engineer

W&D 5706-B

JOY

SINCE 1851—OVER A 100 YEARS OF ENGINEERING LEADERSHIP

EXON: each resin engineered for a specific problem

EXON 480

specifically for

records

High tonal quality and exceptional resistance to breakage are assured when you make "biscuits" with EXON 480.

This Firestone resin provides unique production advantages in the blending, fusing, preforming and molding processes. Its higher bulking density speeds up banbury output as much as 25%.

EXON 480 offers high thermoplasticity, good heat and light stability, and is entirely compatible with the vinyl plasticizers, stabilizers and pigments record-makers most often use.

Continuing Firestone research aids industry by creating such specific resins for specific needs. Whatever your problem, the answer may well lie in this ever-growing line of EXON resins.

Firestone

EXON®

For complete information or technical service on any EXON *resin, call or write today:*

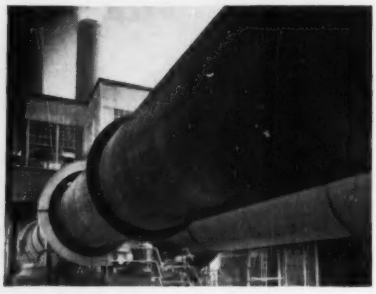
CHEMICAL SALES DIVISION

FIRESTONE PLASTICS COMPANY, POTTSTOWN, PA., DEPT. 28S

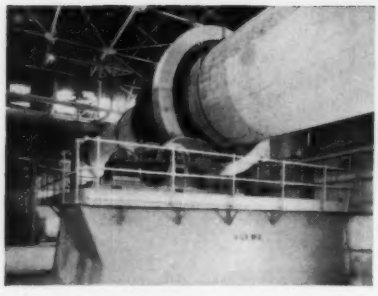
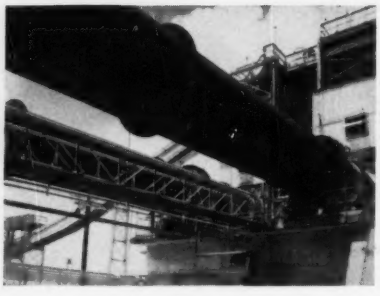
A DIVISION OF THE FIRESTONE TIRE & RUBBER COMPANY

if the average number of Traylor Kilns

built each year were placed end to end



they would extend almost half a mile

THAT MEANS A BETTER ROTARY KILN INSTALLATION FOR YOU

Traylor has averaged almost 1 Rotary Kiln installation a month for the past 14 years. With more than 33,000 feet of Rotary Kiln construction, Traylor has the biggest backlog of experience in the field to draw upon in designing a kiln for practically any thermo-processing operation.

Traylor Kilns have been built in sizes from 3½′ to 12′ in diameter; from 40′ to 425′ in length. They are being used to process some 21 different products.

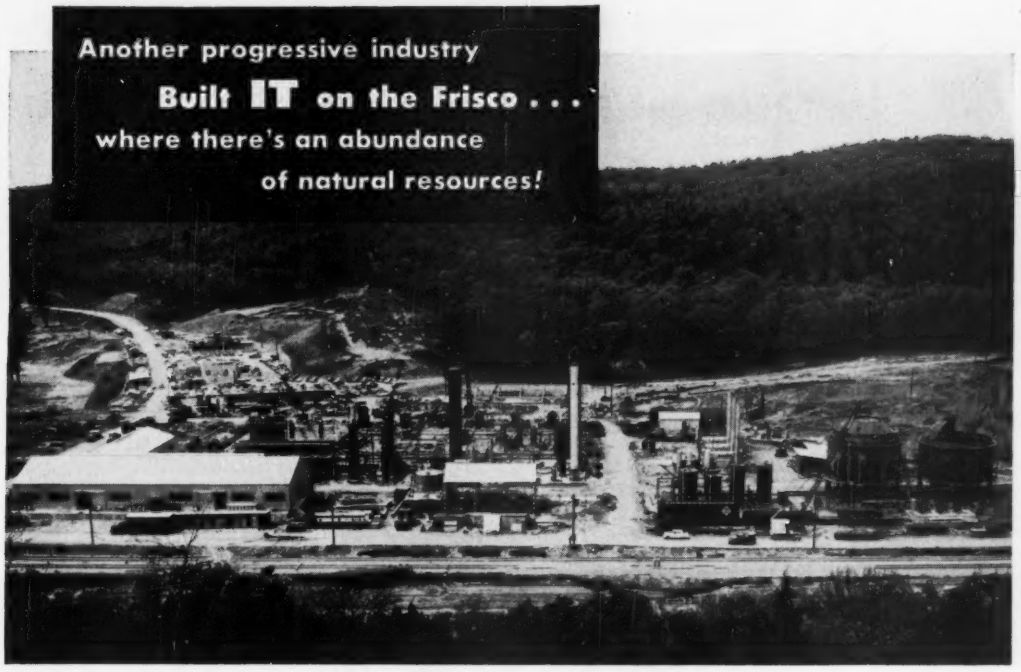
Of the 152 Traylor Kilns built since 1941, no more than any 3 or 4 were alike. Most of these were built for former customers after the initial Traylor installation proved the advantage of "Traylor-made" equipment.

With a "Traylor-made" kiln the law of averages is all on your side to insure the most efficient, economical installation possible. Send for our bulletin 1115.

TRAYLOR ENGINEERING & MFG. CO.
771 Mill St., Allentown, Pa.
Canadian Mfrs.: Canadian Vickers, Ltd., Montreal, P. Q.

A Traylor leads to greater profits

SALES OFFICES · NEW YORK · CHICAGO · SAN FRANCISCO



Water supply, natural resources, markets and rail facilities were primary considerations for the Mississippi River Chemical Company selecting this 4700-acre site near Crystal City, Mo. for its new $15 million petro-chemical plant for manufacturing nitrogen products, such as anhydrous ammonia, nitric acid and ammonium nitrate solutions and solids

Like many businesses that are relocating or adding new manufacturing facilities today Mississippi River Chemical Company Built it on the Frisco where nature's abundance of needed resources will help it build new business!

Yours . . . NO OBLIGATION!

Complete analytical Water Surveys of choice plant sites in the Southeast and Southwest

Looking for an industrial site with king-size water capacity? Mail the convenient coupon below for a series of analytical water survey brochures featuring choice locations now available ranging from 50 to 3,000 acres with water capacities from *10 million* to as high as *37 billion gallons daily!*

Each brochure describes an individual potential industrial site and gives full details about industrial water sources, chemical content, minimum recorded flow, and similar vital information. And each brochure shows site and topographical maps, information on utilities, raw materials, roads, rail and highway transportation.

Mail coupon for these valuable brochures now, while the subject's fresh in your mind. Or write us your requirements today. Your inquiry held in complete confidence.

NO OBLIGATION!
Send for these valuable Industrial Site Water Survey brochures TODAY . . . authoritative, factual data assembled by the Frisco Industrial Development Department.

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H. A. Baker, Assistant to President—Development
St. Louis-San Francisco Railway
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Please send me free brochures that report the many advantages of Industrial Water Sites now available for plant location.

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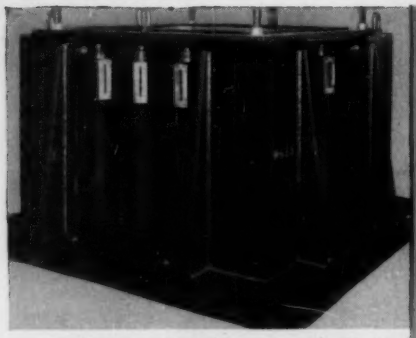
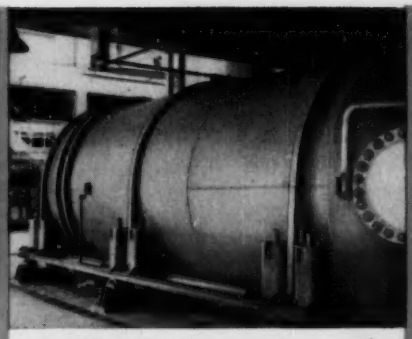
5,000 MILES SERVING:

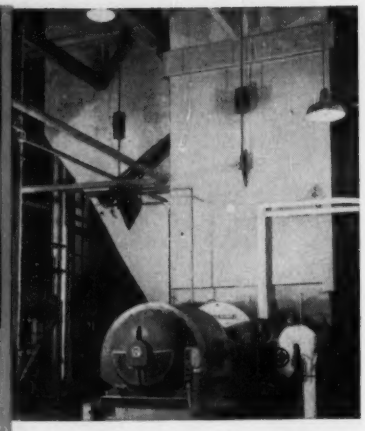
MISSOURI • KANSAS • ARKANSAS • OKLAHOMA • TEXAS • TENNESSEE • MISSISSIPPI • ALABAMA • FLORIDA



Base for supporting refinery tower, provided with Grinnell Spring Hangers for flexible support.



Grinnell Spring Hangers on large vessel of catalytic cracking unit in oil refinery.



Induced draft duct and blower in power station. Operates at about 500°F. Supported by Grinnell Spring Hangers.

To support loads that won't stand still . . .

GRINNELL PRE-ENGINEERED SPRING HANGERS

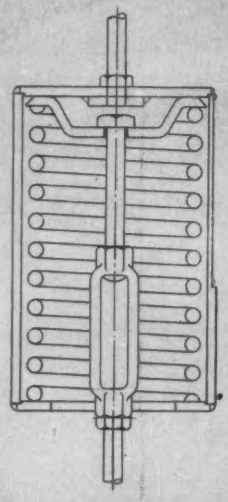
There are many industrial installations where heavy loads must be firmly, but flexibly, supported to keep them under control. Thermal expansion and contraction, of course, can move ponderous objects many inches. Shock and vibration, too, can make rigid support of heavy loads hazardous, due to possible serious trouble at terminals.

For installations such as these, more and more engineers are turning to *flexible* supports by Grinnell. Grinnell Variable Spring Hangers are *pre-engineered* to minimize changes in supporting force over total range of movement. Here are the important features that let these units turn in a star performance in a supporting role:

- Maximum variation in supporting force per ½" of deflection is 10½% of rated capacity — in all sizes.

  Precompression* assures operation of spring within its proper working range, as well as saving valuable erection time. Reduced over-all height saves space.
- Solid steel casing protects spring from damage and weather. Guides assure continuous alignment and concentric loading of spring.
- 18 sizes available from stock — load ranges from 53 lbs. to 12,000 lbs.
- Easy selection of proper sizes from simple capacity table.
- Installation is simplified by integral load scale and travel indicators.

*Precompression is a patented feature.



VARIABLE SPRING HANGER FIG. B-268

Fig. B-268, Type A, is designed for attachment to its supporting member by screwing a rod into a bushing in the top cap of the hanger. Adjustment of the hanger load is accomplished by turning the turnbuckle on the lower hanger rod until the hanger picks up the load and the load indicator points to the desired position. Six other types of attachment are available.

Grinnell Variable Spring Hangers are also available in half sizes (Fig. B-82); and in double spring sizes (Fig. B-98).

GRINNELL

AMERICA'S #1 SUPPLIER OF PIPE HANGERS AND SUPPORTS

Grinnell Company, Inc., Providence, Rhode Island • Coast-to-Coast Network of Branch Warehouses and Distributors

pipe and tube fittings • welding fittings • engineered pipe hangers and supports • Thermolier unit heaters • valves
Grinnell-Saunders diaphragm valves • pipe • prefabricated piping • plumbing and heating specialties • water works supplies
industrial supplies • Grinnell automatic sprinkler fire protection systems • Amco air conditioning systems

A pencil pokes through this corroded metal! Why chance trouble like this? Cathodic Protection and ANACONDA Type CP Cable effectively check corrosion of buried metals.

For longer cable life in cathodic protection —Anaconda Type CP Cable

Moisture, soil acids and alkalies, and —most important — oil are tough on present cables used in Cathodic Protection.

Anaconda's new Type CP Cable is specially designed—with double covering of polyethylene and Densheath* (PVC) — to resist these enemies of cable life. This means less frequent replacement . . . major savings in both labor and material costs.

*Reg. U. S. Pat. Off.

Polyethylene and Densheath used in ANACONDA CP Cable are inherently resistant to oil. And they have high resistance to electro-endosmosis, as well as to moisture and most acids, alkalies and chemicals found in corrosive soil areas. Rugged Densheath jacket withstands toughest abrasion, and weathering.

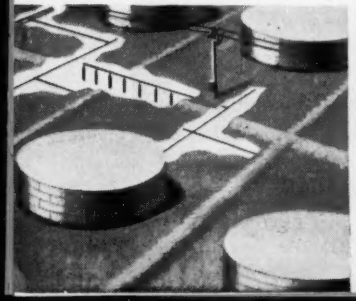
This cable is light . . . easy to install, splice and terminate. Ask the Man from Anaconda—or your Distributor — for full information. Also — write for Bulletin DM 5450: "Anaconda Cathodic Protection Cable." Anaconda Wire & Cable Company, 25 Broadway, New York 4, New York.

55341

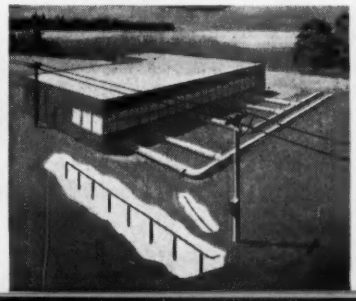
ANACONDA®
COPPER AND ALUMINUM WIRE AND CABLE

Where Anaconda Type CP Cable and Cathodic Protection Cut Corrosion Costs

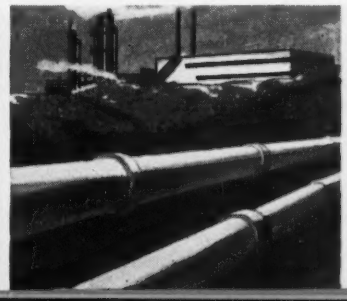
Tank farms



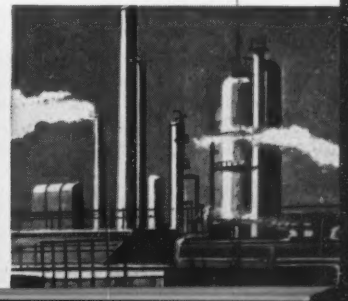
Booster stations

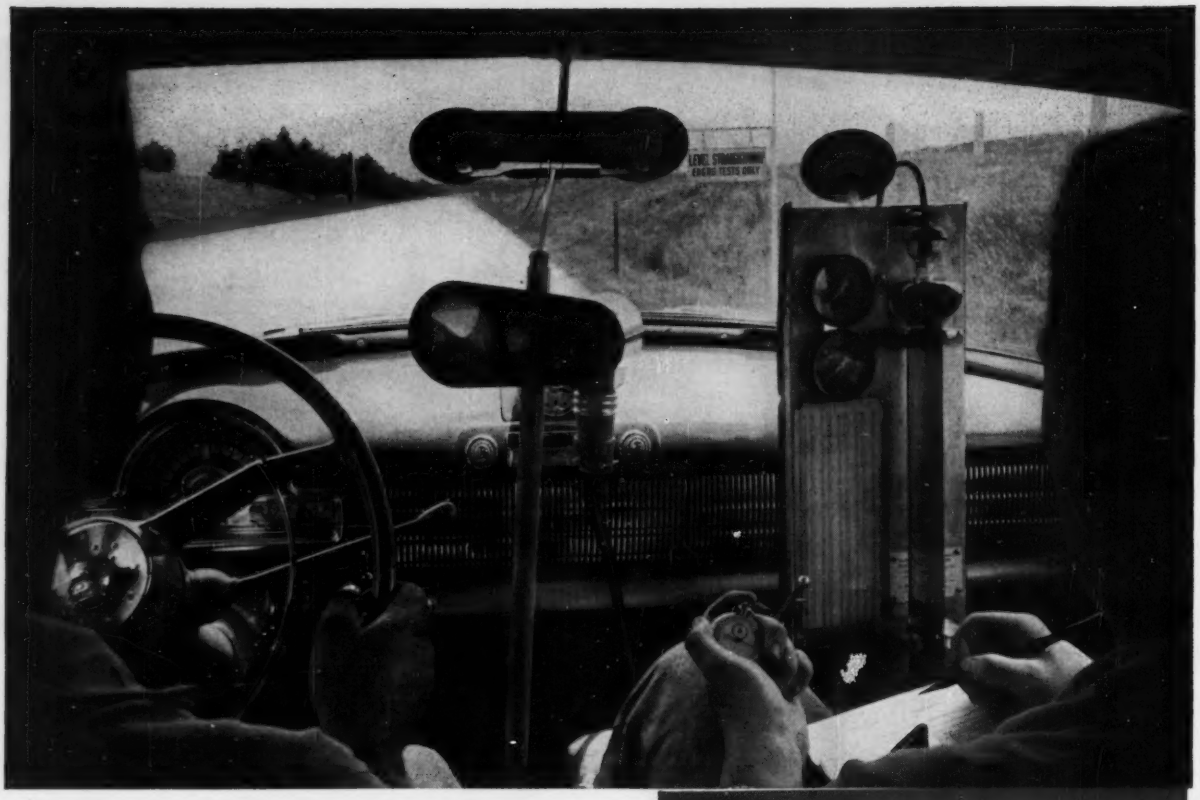


Pipe lines



Oil Refineries



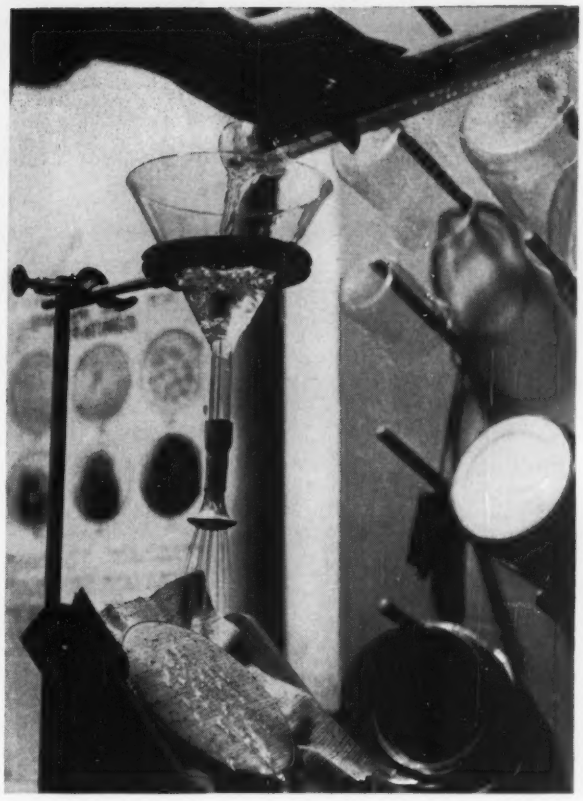


TESTING FUEL ECONOMY of new automobiles is part of Detroit's continuing research to get more power out of gasoline. Burette at right measures fuel consumption. Cyanamid is helping refiners meet the trend toward premium gasoline with a new catalyst—AEROCAT TRIPLE A* High Alumina Catalyst. It is the first catalyst with high alumina content (25%) to prove successful in full-scale commercial use. Offering higher activity and improved selectivity, AEROCAT TRIPLE A Catalyst boosts the efficiency of cracking units. It makes possible greater output of gasoline per ton of catalyst used or better cracking performance at the same rate of catalyst usage. **(Industrial Chemicals Division)**

NOW AVAILABLE IN SOLID FORM, CYANAMER® 370 Acrylic Polymer is water soluble and has unique properties. It is economical in handling and shipping, and has excellent storage stability. CYANAMER 370 is substantially free of extraneous inorganic salts and has no odor of ammonia in solid form or aqueous solutions. CYANAMER 370 is an extremely uniform product which provides excellent thickening action in emulsions and rubber latexes, strong adhesive and binding properties, and will form films from water solution. Solutions are stable over wide pH range and may be coagulated at pH below 3-4. **(Industrial Chemicals Div.)**

Life... on the Chemical Newsfront

EFFICIENT PROTECTION FOR VINYL PLASTICS against discoloration and degradation by the ultraviolet component of sunshine now can be obtained with CYANAMID'S U.V. ABSORBERS. These compounds are substituted benzophenones and they protect by converting destructive ultraviolet into harmless heat. CYANAMID'S U.V. ABSORBERS impart longer life and greater utility to a wide range of vinyl plastics and coating materials. **(New Products Dept.)**



UNIFORM PERFORMANCE THROUGH QUALITY CONTROL is an important feature of CYANA® Textile Finishes. A durable finish such as CYANA PERMEL PLUS® imparts water repellency, spot and stain resistance, and wrinkle resistance to cotton, acetate, nylon, rayon, and blends. In addition, garments made from fabrics treated with PERMEL PLUS Finish not only retain their smart appearance but also wear longer. **(Organic Chemicals Division)**

News Briefs

CALCOFLUOR* WHITE RWS, NEW WATER-SOLUBLE WHITENER, has been developed to facilitate application to textiles made of wool, nylon, acetate, pure silk, and Orlon† acrylic fiber. Now, white and colored garments made from these treated textiles will be whiter and brighter than those made from untreated textiles. **(Organic Chemicals Division)**

SURGILOPE* STERILE PACK is a new and important advancement in packaging sterile sutures for medical use. Developed by Davis & Geck, Inc., a Cyanamid subsidiary, SURGILOPE provides a double envelope of metal foil and glassine to replace glass tube packaging. It is safer to handle, saves time in opening, and requires one third less storage space. At present, SURGILOPE is available only with ANACAP® black silk sutures. However, other sutures will be included as soon as production facilities permit. Samples will be sent to hospitals on request. **(Davis & Geck, Inc.)**

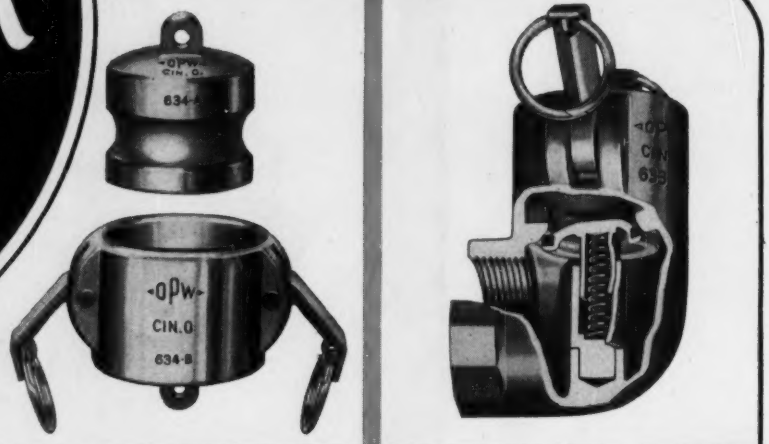
FOR PROMPT RELIEF OF PAIN from peptic ulcers, physicians can now prescribe PATHILON® Iodide Tridihexethyl Iodide. Developed by Lederle Laboratories Division of Cyanamid, this remarkable drug relieves gastrointestinal spasms by blocking the nerve impulses which control the smooth muscle lining of the stomach and intestines. **(Lederle Laboratories Division)**

†Du Pont trade-mark **Trade-mark*

C.E.

Additional information may be obtained regarding these products by writing on your business letterhead to the Division of American Cyanamid Company, 30 Rockefeller Plaza, New York 20, N. Y., indicated in the captions.

KAMLOK COUPLING ASSEMBLIES



The Fastest Surest Coupling Known!

KAMLOKS positive seal all along the line assures *greater safety* in handling any type of liquid. A perfectly tight no leak connection is made in seconds by sliding coupler over adaptor, then pressing cam levers. No threads to engage, no twisting friction against gaskets, no tools required. KAMLOKS provide long years of economical trouble free service.

Available in any combination to meet coupling requirements in sizes from ¾" to 4" inclusive. Sizes ¾" to 3" precision machined of special hard wear resistant bronze. 4" size of hi-tensil OPALUMIN, (OPW hi-tensil aluminum alloy requiring no additional heat treating). 4" in bronze on special order.

Parts A, E, F, are interchangeable with parts B, C, D, G, H, in the same size.

BRONZE • ALUMINUM • MONEL

FREE BULLETIN—*F 10 tells the Complete Kamlok Story.*

OPW CORPORATION FOR HANDLING HAZARDOUS LIQUIDS — OPW — VALVES • FITTINGS • ASSEMBLIES — CINCINNATI 25, OHIO

OPW CORPORATION

2725 COLERAIN AVE. • CINCINNATI 25, OHIO

A Challenge!

. . . to write for the two No. 1 publications in the Chemical Process Industries

If you have always had a hankering to write . . . to get into technical editorial work . . . to organize your ideas and then put them on paper . . . to visit plants and to meet people . . . this may well be the opportunity you've been looking for.

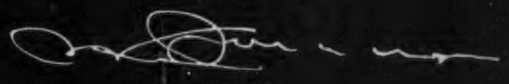
Our magazines need several junior editors interested in personal growth and job satisfaction. Here are the basic qualifications:

CHEMICAL WEEK wants young men to help expand its editorial services to management in the chemical process industries . . . graduate chemists or chemical engineers with 2 to 5 years of experience in research or production, in equipment design or sales, in distribution, market research or technical service. There's an especially attractive opening for a chemist or engineer familiar with financial problems . . . ideally, a chemist with post graduate training in business management and economics.

CHEMICAL ENGINEERING is looking for a Ch.E. graduate with up to 3 years of experience, able to write clearly, logically. Personality-wise, he should be able to accept ideas from others . . . work as a member of a closely knit team . . . be eager . . . unafraid of work . . . inquisitive and open-minded, with plenty of personal drive.

Both magazines have headquarters in New York City, with McGraw-Hill, world's largest publisher of business papers and books. If you think you can meet the challenge of one of these editorial opportunities, send us details on your personal background, experience, approximate salary requirements, along with any evidence of your writing ability. All replies will be treated confidentially.

John R. Callaham, Editor
Chemical Engineering



W. Alec Jordan, Editor
Chemical Week

330 West 42nd Street, New York 36, New York

P.S. If more convenient, you may obtain additional information from these regional editors:

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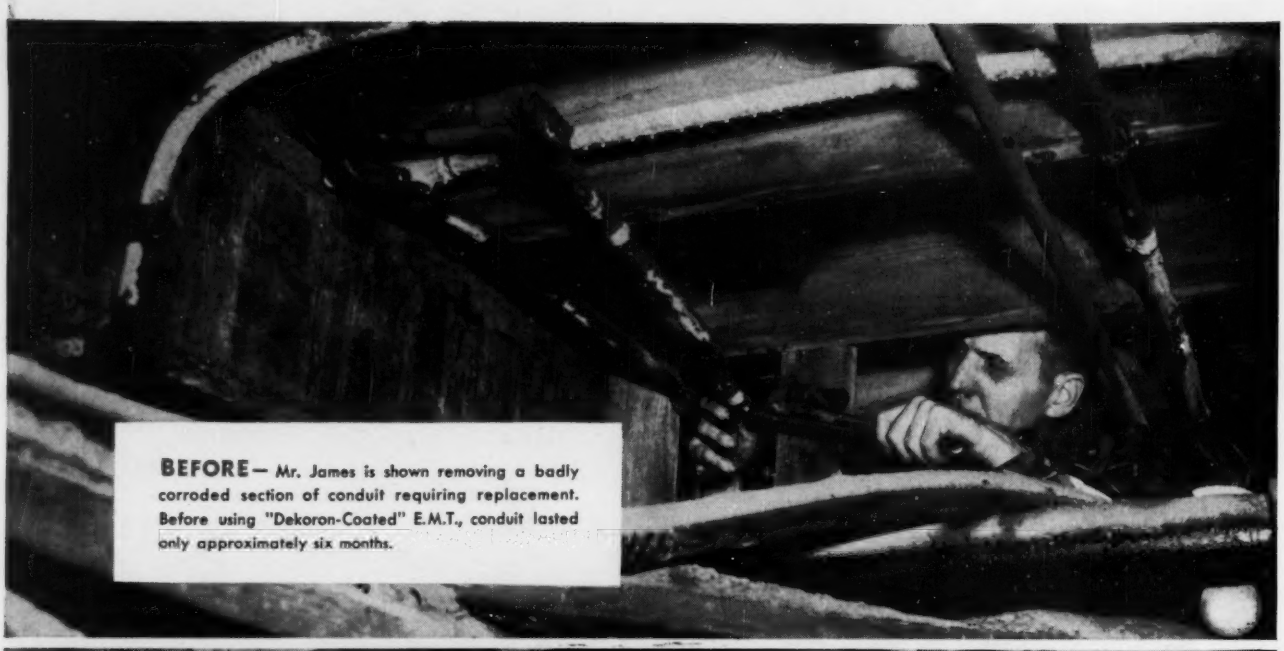
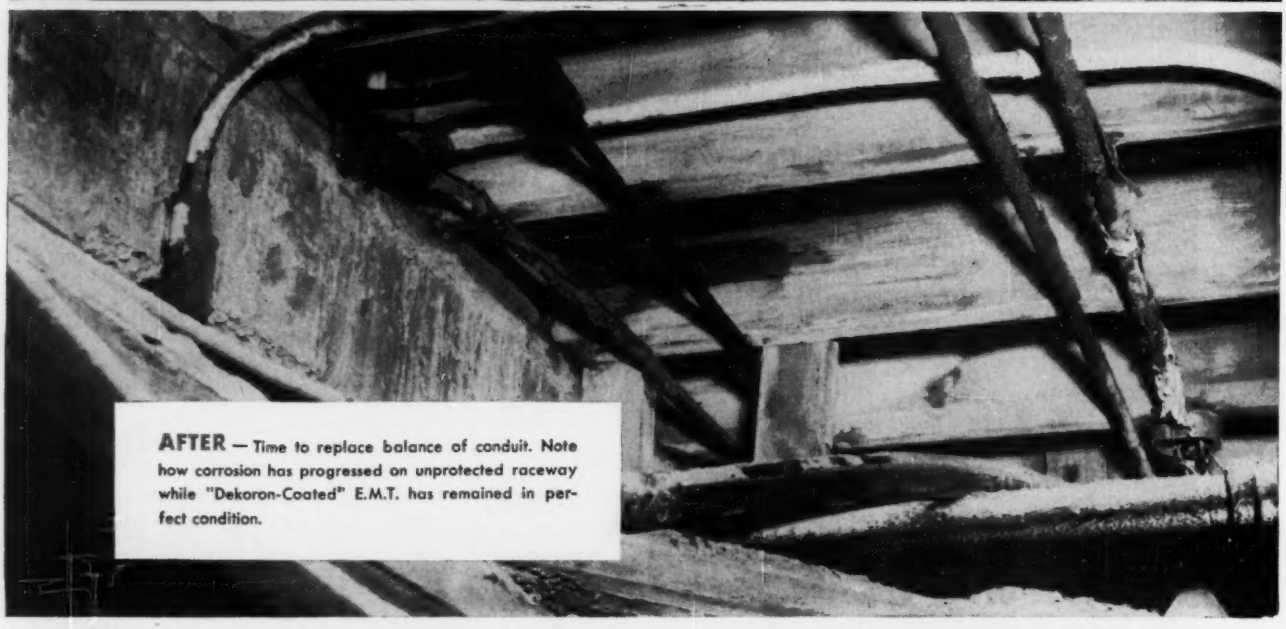
1303 Prudential Bldg.
Houston 25, Texas

Frank C. Byrnes
520 N. Michigan Ave.
Chicago 11, Illinois

Elliot Schrier
68 Post Street
San Francisco 4, Calif.



BEFORE— Mr. James is shown removing a badly corroded section of conduit requiring replacement. Before using "Dekoron-Coated" E.M.T., conduit lasted only approximately six months.



AFTER — Time to replace balance of conduit. Note how corrosion has progressed on unprotected raceway while "Dekoron-Coated" E.M.T. has remained in perfect condition.

REPUBLIC STEEL CORPORATION
3116 East 45th Street
Cleveland 27, Ohio

Please send me more information on:

☐ "Dekoron-Coated" E.M.T. ☐ Enduro Stainless Steels
☐ Containers ☐ Titanium

Name_____ Title_____

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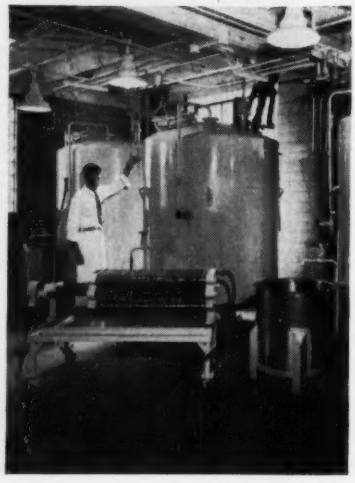
K-7656

MAINTENANCE SAVINGS — One of the world's leading pharmaceutical manufacturers has realized substantial maintenance savings through the use of Republic Enduro® Stainless Steel in these insulin-purification-process collection tanks. Ease of cleaning is the secret. Enduro presents a smooth, hard surface. It has no applied finish to crack or pit . . . no place for contamination to hide. Perfect sterilization is simplified. And in addition, Enduro's high restisance to corrosion keeps critical processes pure. Call Republic for complete information on how this miracle metal can pay you dividends, too.



Report from Electro Manganese Corp., Knoxville, Tennessee:

"That's right . . . and we'll save even more," says Mr. Walter James, Maintenance Engineer for Electro Manganese.

"In the manufacturing of Electrolytic Manganese, acidic fumes and mist are given off. This gives us an extremely corrosive atmosphere and, as a result, we had to make frequent replacement of conduit.

"Now, however, we've had ELECTRUNITE® 'Dekoron-Coated' E.M.T. installed for over a year; and it's still going strong! Our specifications call for it as the standard Electrical Metallic Tubing to be used."

This is a typical report taken from a large and growing list of satisfied users of Republic ELECTRUNITE "Dekoron®-Coated" E.M.T. From chemical plants to coal mines, this raceway gives your electrical circuits the moisture, fire and mechanical protection of steel *plus* the complete corrosion protection of its exclusive extruded polyethylene plastic coating.

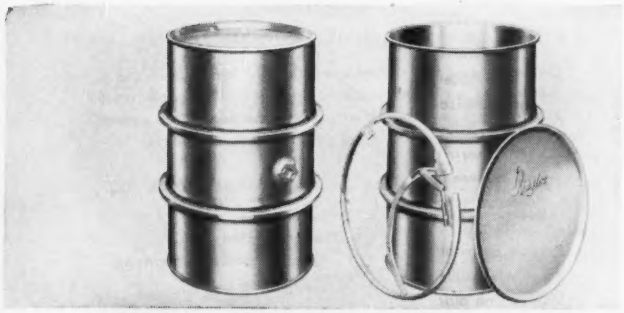
One last point—"Dekoron-Coated" E.M.T. installs almost as easily as regular E.M.T. It requires no special tools or fittings. And by wrapping couplings and connectors with plastic tape, corrosion protection is assured throughout the entire run. Republic Rigid Steel Conduit, too, is available with this modern protective coating.

"We've already saved over 50% on conduit replacement with REPUBLIC "Dekoron-Coated" EMT!"

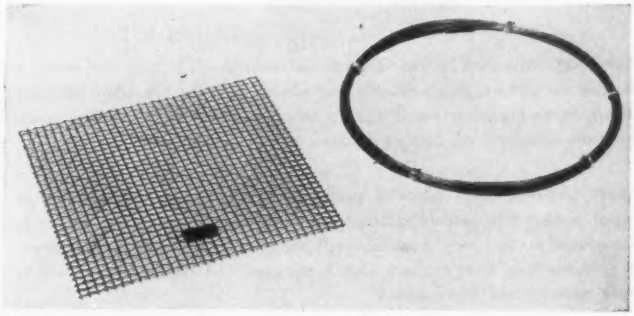
Your Republic Steel and Tubes Representative will be glad to give you complete details on "Dekoron-Coated" E.M.T. Or mail the coupon for literature.

REPUBLIC STEEL

World's Widest Range of Standard Steels and Steel Products



PROTECT YOUR PACKAGED ITEMS by shipping or storing them in Republic Steel Containers. Drums and barrels of ENDURO Stainless Steel give maximum protection against product contamination. Enduro neither affects nor is affected by most chemicals and food products. Resists corrosion. Resists hard use and abuse. Never needs painting. Lasts indefinitely. Many styles to choose from in sizes up to 55 gallons. Mail coupon on opposite page for further information.



TITANIUM HAS ALL THREE . . . high strength, lightweight and excellent corrosion-resistance. Republic metallurgists know these properties. Whether you want to make titanium wire or wire cloth, as shown, or forgings, or do any of a variety of machining operations, you can rely on Republic for working information. And since Republic now offers nine grades of titanium and titanium alloys in wire, bars, billets, sheets and plates—in addition to the world's widest range of steels—you receive impartial advice. Just call your Republic representative or mail the coupon.

for TOUGH fluid and gas handling jobs

ATLANTIC

FLEXIBLE METAL HOSE

Conveying nitric acid for use in batch nitrations is quick death for ordinary flexible metal hose. Sulphuric acid and plating solutions are other notorious killers. When temperature and pressure extremes and adverse handling conditions are also involved, hose replacement is frequent and expensive.

That's why—for tough jobs—it's good economy to specify Atlantic flexible metal process hose. Manufactured to survive the most destructive use, it is unequalled for leak-proof qualities, flexibility, durability, strength and lightness. It performs long after ordinary hose is scrapped and returns real savings in your material and labor dollar.

Whatever your application — conveying, controlling movement and vibration, correcting misalignments, compensating for expansion and contraction — *there is an Atlantic flexible metal hose that is best for it.*

Available in Seamless or Interlocking construction: Steel, stainless steel, monel, bronze. ⅛"—36" I.D. inclusive with appropriate fittings.

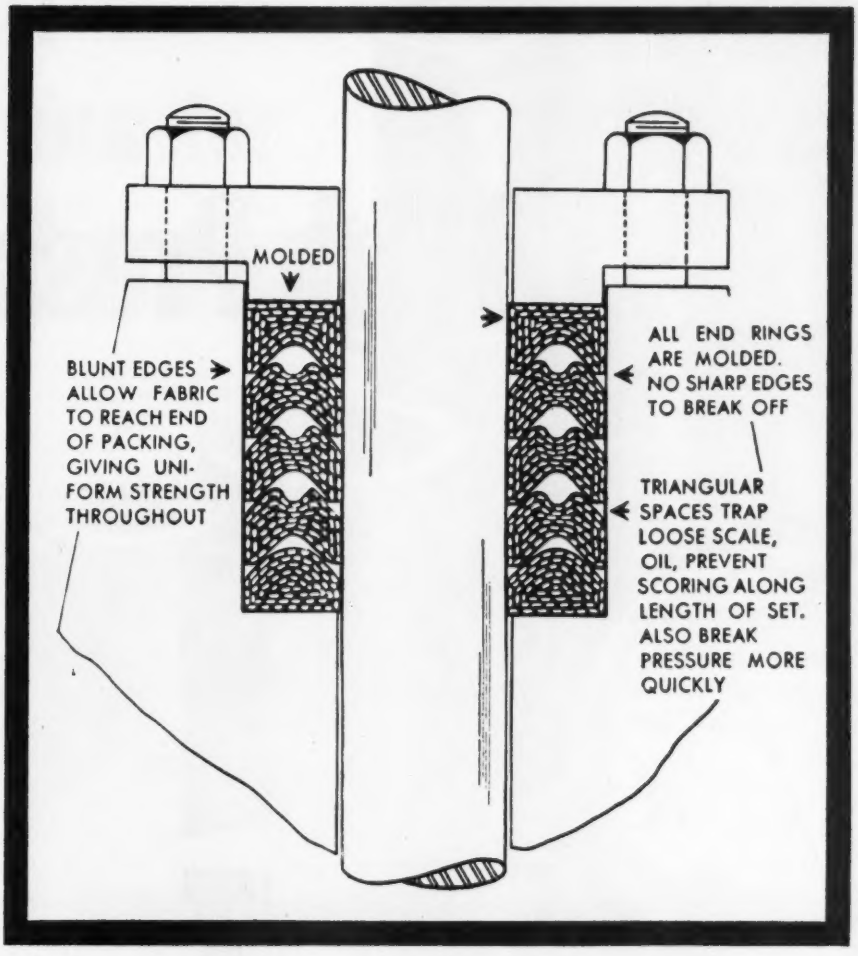
Our engineers have developed flexible metal hose for a number of classified nuclear applications. Though these types cannot be released at present, the experience gained is available for any unusual problems you may have.

Write for Chemical and Process Industries Bulletin 20D.

See our Catalogs in Sweet's Files for Product Designers and Mechanical Industries.

ATLANTIC METAL HOSE CO., INC.
329 Dyckman St., New York 34, N. Y.

Count the design advantages packed into U. S. "Matchless" Packing!


MOLDED
BLUNT EDGES ALLOW FABRIC TO REACH END OF PACKING, GIVING UNIFORM STRENGTH THROUGHOUT
ALL END RINGS ARE MOLDED. NO SHARP EDGES TO BREAK OFF
TRIANGULAR SPACES TRAP LOOSE SCALE, OIL, PREVENT SCORING ALONG LENGTH OF SET. ALSO BREAK PRESSURE MORE QUICKLY

BLUNT EDGES—Give more efficient shape; allow fabric to reach end of packing, providing uniform strength throughout. In ordinary packing (feather-edge design) fabric can't be forced into sharp edge, leaving unprotected soft-rubber end to cause curling, chipping.

TRIANGULAR SPACED—Blunt edges provide triangular spaces for trapping loose scale, oil, etc. Result is lower coefficient of friction, less power required, and scaling does not score entire length of packing set.

PRESSURE BREAK—The triangular space of each ring breaks the pressure more quickly than ordinary types without this feature. With "Matchless" design, automatic action is faster, more effective.

MOLDED END RINGS—Tests show the female ring and the one next to it take 70% of the pressure on the set. In "Matchless" *all* rings are molded, are of proper density, and have no sharp edges to break off, as on end rings cut from slab.

U. S. Packings are obtainable through any of United States Rubber Company's 27 District Sales Offices or selected Distributors.

Write for catalog giving complete dimensions and design data

"U.S." Research perfects it..."U.S." Production builds it...U.S. Industry depends on it

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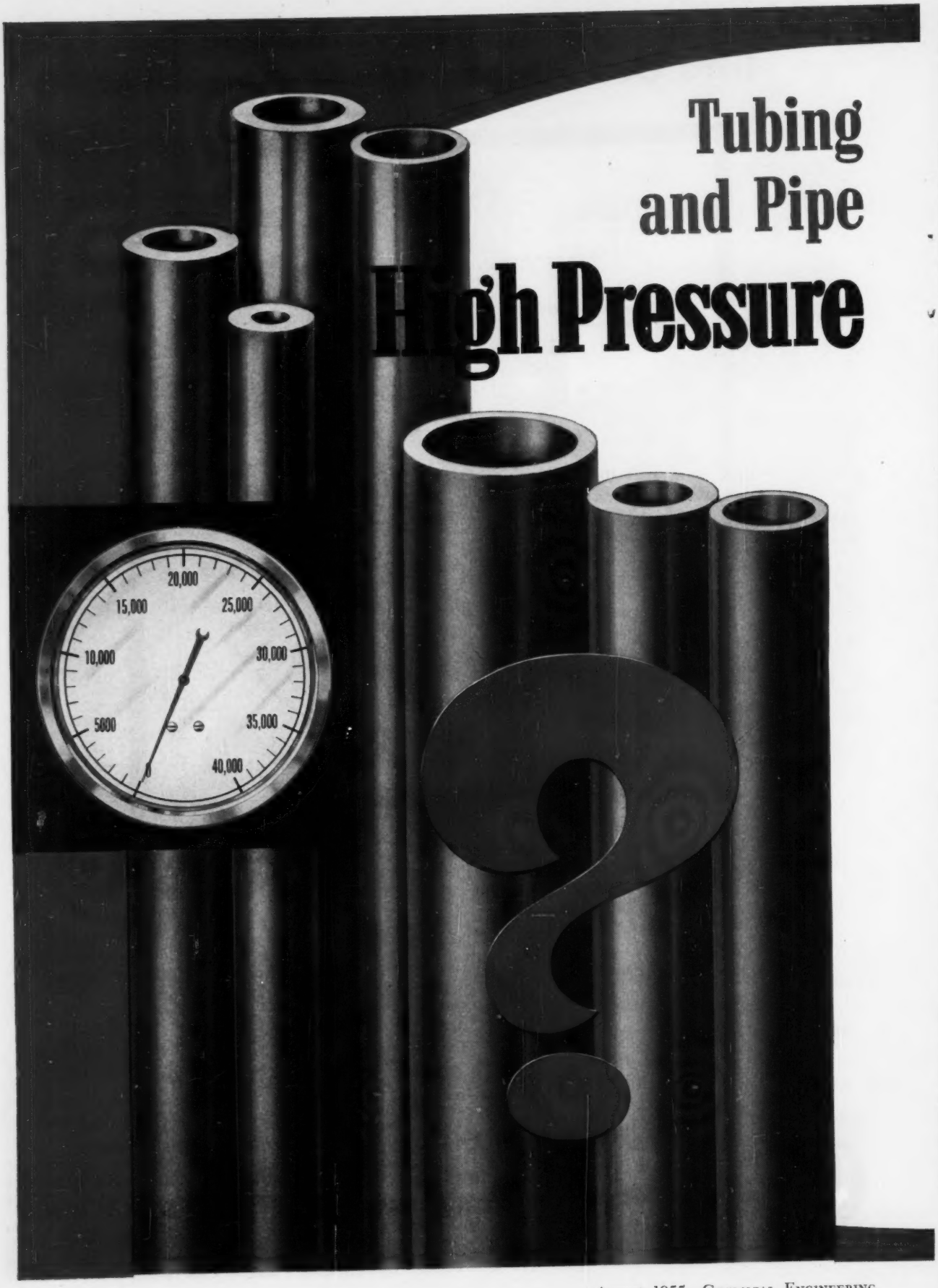
Tubing and Pipe for High Pressure



Selection for Applications

Specific working pressure is one of the major considerations in the choice of tubing or pipe for a given fluid-handling application. To obtain optimum efficiency and economy, however, it is necessary to consider temperature conditions, tube size, mechanical strength of the steel, and corrosion hazards.

A case in point that clearly shows the complexity of selecting the right tubing for pressure applications involved the installation of a stabilized stainless steel to carry methanol and unreacted synthesis gases at 300 F and 5000 psi while being exposed to chloride-bearing bayou water. This exposure caused pitting corrosion which, in turn, localized the pressure stresses at the roots of the pits causing, eventually, failure by stress corrosion. To effectively solve this costly problem, B&W with its long experience in all phases of tubing applications, helped in selection of B&W Croloy 5. This choice provided increased resistance to the pitting while meeting the temperature and pressure factors satisfactorily *and at a substantial savings in material cost.*

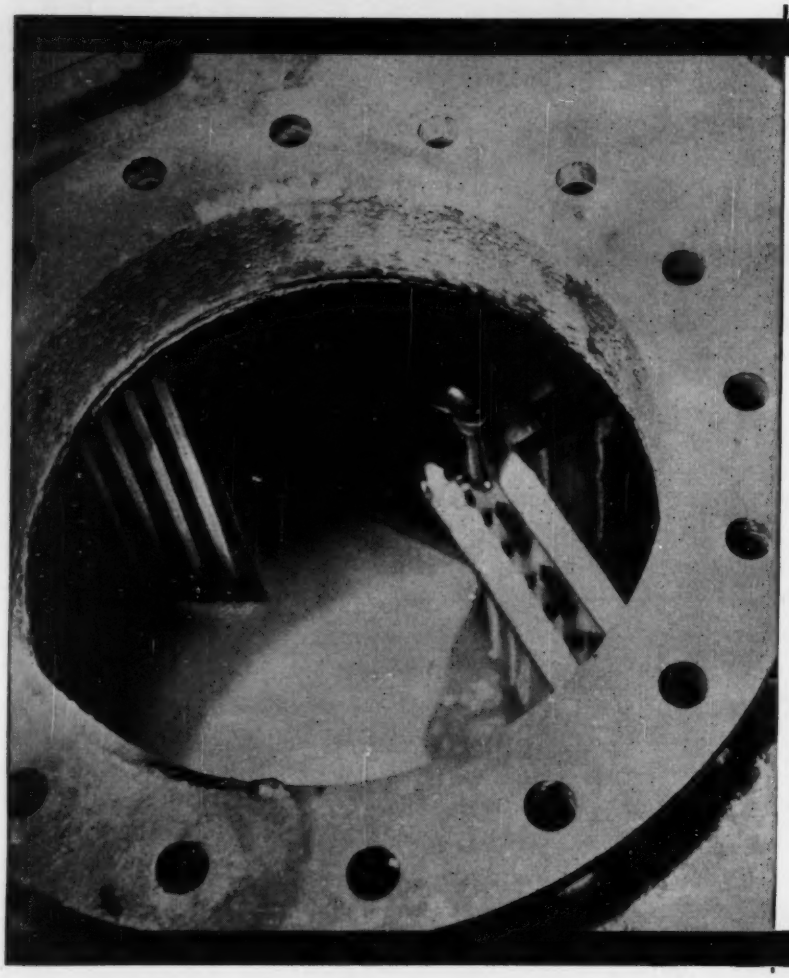
It takes an expert to specify the optimum tubing or pipe for any particular application. And there is no substitute for the kind of experience with such problems that you will find at B&W. To get the most benefit from B&W's long experience in matching tubes and piping to jobs—call on Mr. Tubes, your nearby B&W Tube Representative. *Or write for Bulletin 6.*

THE BABCOCK & WILCOX COMPANY
TUBULAR PRODUCTS DIVISION
Beaver Falls, Pa. and Milwaukee, Wis.: Seamless Tubing, Welded Stainless Steel Tubing
Alliance, Ohio: Welded Carbon Steel Tubing
Milwaukee, Wis.: Seamless Welding Fittings

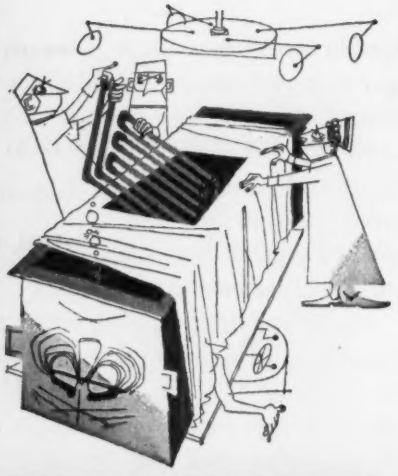
TA-3041(P)

new PLATECOILS®

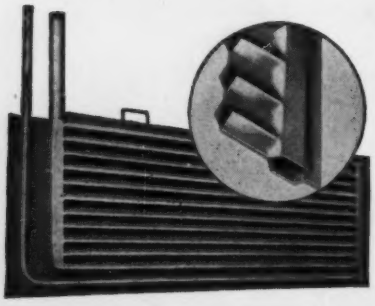
cost less than pipe coil repairs...



as Coil-itis* is cured in this Sherwin-Williams agitated tank



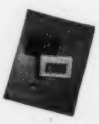
Platecoils have replaced a large circular pipe coil formerly used to cool alkaline slurry in an agitated tank at Sherwin-Williams Company. Installed on end, Platecoils are inserted or withdrawn through a manhole on the top of the tank. With pipe coils, it was necessary to remove the motor and agitator and the bolted-down tank top to make repairs. Cost of doing this just once exceeded the total cost of the 6 Tranter Platecoils now used. In addition, cooling is now accomplished without fouling of surface, which means the cooling is more effective and maintenance is decreased. Such outstanding savings are possible with Platecoils. Investigate them for your processes today. For heating as well as cooling, Tranter Platecoils are your best answer.



PLATECOILS *replace pipe coil for 50% of the cost*

*Besides reducing original costs, Tranter Platecoils frequently save 50% in maintenance costs. And production time is saved because Platecoils heat or cool 50% faster and payloads are increased because Platecoils take 50% less tank space. By overcoming the limitations of old-fashioned pipe coils, Platecoils cure Coil-itis.

Write today for a 12-company report on savings made by use of Tranter Platecoils. Ask for Bulletin No. P61.



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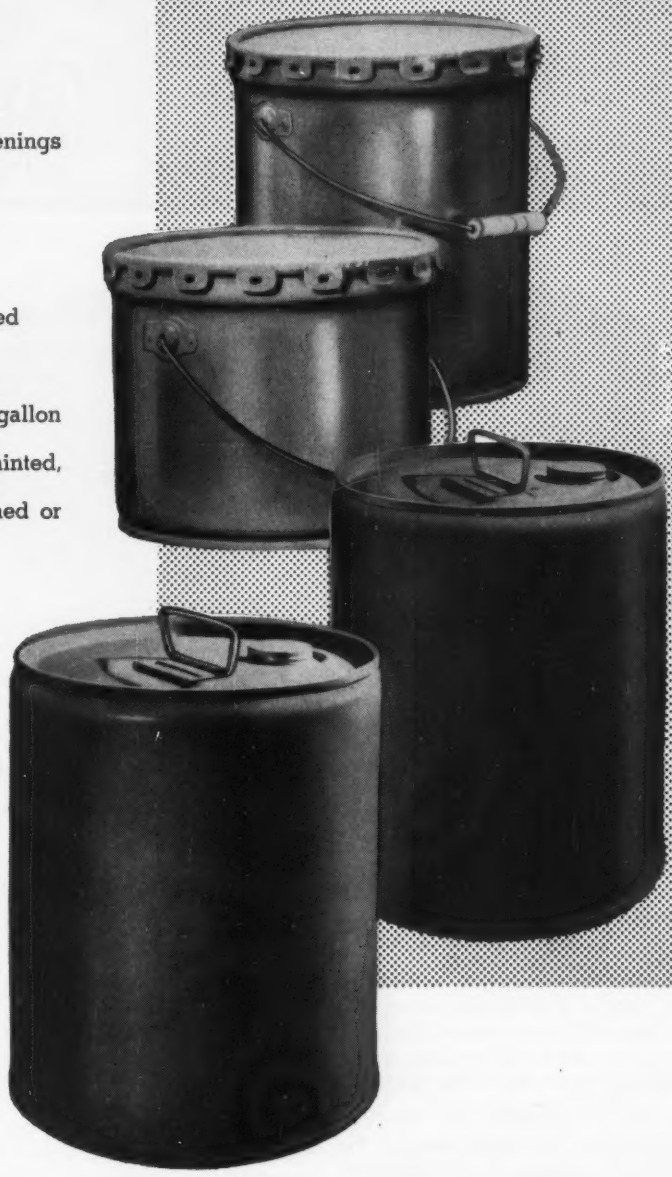
- Available in 3- to 6½-gallon capacities
- With tight heads or lug covers
- Wide variety of pouring spouts and openings
- Baked enamel finishes in any color combination
- Lithographed heads or shells as required

We also have steel drums of 15- to 55-gallon capacities which can be furnished painted, decorated, hot dipped galvanized, tinned or made of stainless steel.

"It's Better to Ship in Steel"



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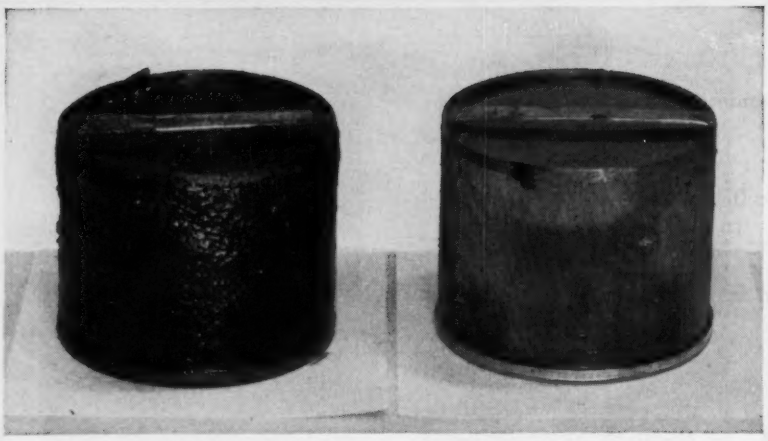
UNITED STATES STEEL

for your information...

brief summaries of helpful product news



Ordinary Uninhibited Fuel Oil

Gummy fuel oil sludge and sediment clog screen after only two-hour circulating pump test. Result: oil burner parts operate less efficiently, causing eventual breakdown and costly parts replacements.

Same Fuel Oil with Santolene H

Screen remains clean after two-hour circulating pump test. Santolene H keeps burner parts working smoothly, more efficiently by preventing progressive polymerization of unstable elements in the oil.

New fuel oils using Monsanto additives prevent screen clogging and tank rusting

Progressive production experts in the chemical field are taking advantage of the increased efficiency features which oil companies are building into their new and improved fuel oil products.

These features, which increase the operating efficiency of oil burners, are made possible through the use of Monsanto job-engineered additives—Santolene* H & J—to prevent screen clogging and sludging.

Santolene H, in addition to alleviating sludge and sedimentation, also overcomes screen clogging; eliminates fogging and line freeze-up caused by fuel oil-water emulsions. It keeps burner parts clean and inhibits tank rust by forming a protective coat on tank and other metal surfaces.

Santolene J, a top-quality fuel oil additive, also inhibits rust by preventing formation of water haze or stable emulsions. In addition, this product stabilizes color and reduces sediment formation by preventing agglomeration of insoluble color bodies.

For full technical information on Santolene H, send for technical bulletin O-87; for technical data on Santolene J, bulletin O-97.

Keep cooling systems free of slime and algae with Santobrite

In most recirculating industrial cooling water systems, serious fouling of water passages may result if slime deposits caused by growth of bacteria and algae are not checked.

Monsanto Santobrite,* sodium pentachlorophenate, technical, keeps cooling systems free of these slime-forming organisms. It is non-corrosive to common metals, compatible with other chemical treatments given to cooling water, and is simple to use. Santobrite, a stable material and easily soluble in water, is available in three physical forms—powder, pellets and briquettes.

New Adipic Acid bulletin features literature survey

A new 36-page technical bulletin on adipic acid has just been published by Monsanto. Highlight of the bulletin is the extensive literature survey it contains. More than 80 patent and literature references describing numerous products are summarized. Other sections discuss the properties, toxicity and general chemistry of this versatile compound.

The bulletin was written primarily for research chemists and manufacturers interested in using adipic acid to make a variety of coating, molding and spinning resins and

Plasticizers	Paper finishes
Surfactants	Insect repellents
Adhesives	Textile chemicals
Waxes	Lubricants, etc.

Resins made with adipic acid have an inherent flexibility which by-

passes the need to plasticize harder resins. One advantage is increased durability of finished products. Adipic acid, of course, has long been used to make nylon.

Other interesting applications are elastomers and isocyanate-foamed polyesters from adipic acid. These possess amazing durability and are used as rubber substitutes, insulating, soundproofing, upholstery, and other materials.

Send the handy coupon for your copy of Tech. Bulletin O-105.

HB-40 is economical extender plasticizer

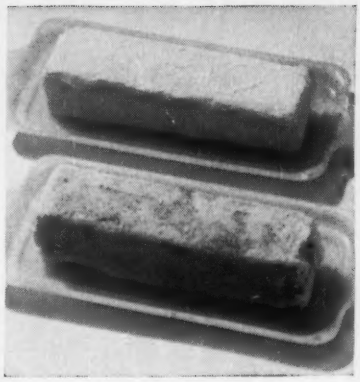
A low-cost, clear, mobile, high-boiling hydrocarbon, HB-40 is widely used as a secondary plasticizer in polyvinyl chloride formulations.

Now available in sufficient supply to meet expanding industry requirements, HB-40 is suggested for use as an extender plasticizer in plastisols for slush moldings and coatings, in vinyl floor tile with special emphasis on asbestos-filled tile, and in filled extrusions, including those for SPT wire.

Check and mail the coupon for your copy of Technical Bulletin P-104.

Handy solubility tables featured in new Vanillin and Ethavan literature

The solubility of both Vanillin Monsanto and Ethavan* (Monsanto's ethyl protocatechuic aldehyde) in water, alcohol-water, glycerine-water and propylene glycol-water mixtures is now shown in table form in the two new product folders just issued. This information will be of major interest to all seeking new ways to better the quality of baked goods, confections, flavors, candy, beverages, perfumes, pharmaceuticals, and soaps. For your copy of either or both of the informative folders, use the handy literature order coupon.



Sodium Benzoate: Low-cost insurance against food spoilage

Graphic evidence of sodium benzoate's role in preventing food spoilage is shown in this unretouched photograph of margarine.

In margarine, as in other perishable food products, including fruit juices, syrups, jams, jellies, etc., 1/10th of 1% of sodium benzoate offers low-cost insurance against bacterial action.

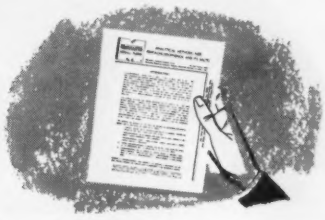
While today's efficient and streamlined methods of manufacturing and distribution have greatly reduced the incidence of spoilage, the addition of inexpensive, readily available sodium benzoate to perishable foods gives assured protection.

For more information, send for the leaflet: "Preserving with Sodium Benzoate."

*Reg. U.S. Pat. Off.

New bulletin describes analytical methods for Penta and its salts

A new technical bulletin, O-24, covering 10 years' research work on methods for detecting pentachlorophenol in treated products, has just been published by Monsanto.



Essentially a *laboratory manual*, the booklet gives detailed instructions for the detection of penta, its sodium salt, and certain closely related phenols.

This revised bulletin details six methods suitable for the detection of penta and also contains a section dealing with the preparation for analysis of such diverse materials as wood, asphalted felt, soybeans, cotton-seed meal, and many others.

The analytical methods presented represent a variety of techniques, one or more of which can be adapted to almost any laboratory facility. For your copy, just check the coupon and mail it to Monsanto.

MONSANTO CHEMICALS – PLASTICS

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MONSANTO CHEMICAL COMPANY
808 North 12th Street, St. Louis 1, Mo.

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I would like to receive the following:

- ☐ Santolene H, Tech. Bul. O-87
- ☐ Santolene J, Tech. Bul. O-97
- ☐ Adipic Acid, Tech. Bul. O-105
- ☐ "Preserving with Sodium Benzoate"
- ☐ HB-40, Tech. Bul. P-104
- ☐ "Ethavan: Superior Flavoring Material"
- ☐ "Where Purity is Essential: Monsanto Vanillin"
- ☐ Penta Analytical Methods, Tech. Bul. O-24

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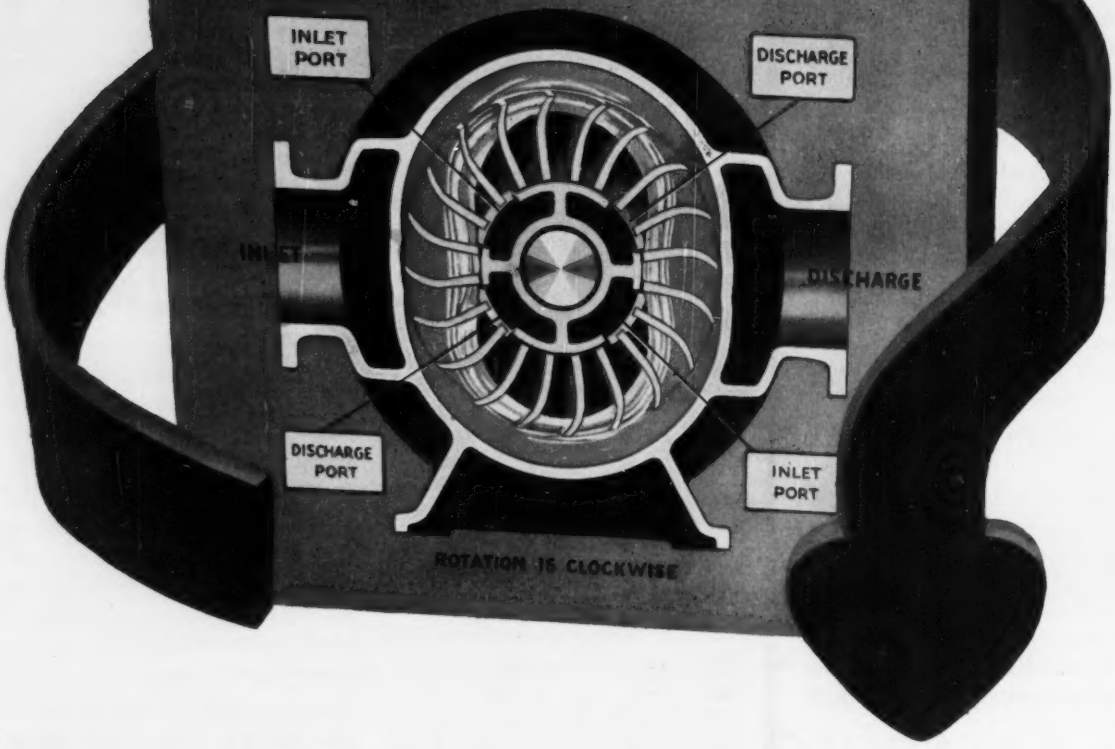
Nash Instrument Air Compressors deliver only clean air, free from oil or dust, and without filters



Here is Why!

You can dispense with oil filters and dust filters when you install ®Nash® Clean Air Compressors. You can save the cost of maintaining these devices. You can greatly reduce instrument maintenance costs. For the Nash employs no internal lubrication, therefore no troublesome oil is in the delivered air. Moreover, air from a Nash is thoroughly washed and cooled as it passes thru the pump. Dust in the plant atmosphere, even fly ash, is immediately removed.

®Nash® Clean Air Compressors are simple, with only one moving element. No valves, gears, pistons, sliding vanes, or other enemies of long life and constant performance complicate a Nash. No aftercoolers are needed. You will find it profitable to investigate these pumps, now.

No oil filters.
No dust filters.
No internal lubrication to contaminate air handled.
No internal wearing parts.
No valves, pistons, or vanes.
Non-pulsating pressure.
Original performance constant over a long pump life.
Low maintenance cost.

NASH ENGINEERING COMPANY
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U.S.I. CHEMICAL NEWS

July-Aug. ★ A Series for Chemists and Executives of the Solvents and Chemical Consuming Industries ★ 1955

ATTENTION

Users of Taxfree and Specially Denatured Alcohol

Now is the time for users of specially denatured alcohol to renew their basic permit (Treasury Department Form 1479) for 1956. It is also time for users of taxfree alcohol to complete and file with the Assistant Regional Commissioner—Alcohol and Tobacco Tax Division—their application (Form 1450) for renewal of their Taxfree Alcohol permit for 1956.

Permittees who withdraw industrial alcohol in drums should note that U.S.I. and most of the chemical industry will increase standard filling of drums to 55 wine gallons each (currently 54 gallons) at the start of 1956. It is recommended that total gallonage of renewal permits be calculated to cover withdrawals in multiples of 55.

If you require renewal forms or any assistance in their preparation, please call your nearest U.S.I. office.

U.S.I. High Molecular Weight Polyethylene Will Coat Paper Too

U.S.I.'s Petrothene 200, an all-purpose polyethylene resin developed for extrusion of packaging film and molding of semi-rigid forms, exhibited some unexpected characteristics during tests recently. The resin was successfully extruded as a laminate for paper coating, an application usually reserved for lower molecular weight types.

At the same time, the material was extruded successfully as unsupported lay-flat tubular and flat film forms, the most demanding operation for high molecular weight types of polyethylene. Further tests are being conducted to confirm the unexpected versatility of Petrothene 200.

Chemical Producers Going To New Drum Standard

As a move toward higher materials handling efficiency, more and more chemical and petroleum producers are going to drums with both openings in the head, none on the side. The drum commonly in use today has a two-inch opening on the side and a ¾ inch opening in the head, and frequently complicates handling in a customer's plant. U.S.I. is switching to the new drum on some of its products within the next few months.

The new type drum meets the Universal Standard Drum Specifications as set up by the Petroleum Packaging Committee and the Steel Shipping Container Institute.

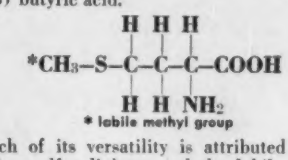
METHIONINE CALLED "MIRACLE" AMINO ACID

Versatility of Methionine Leads to Increased Use in Pharmaceutical, Medical, Veterinary Fields: Is Now Playing Vital Role in Animal Nutrition

Outstanding results with methionine have prompted a leading medical authority to suggest that this essential sulfur amino acid may in the future be as important as today's "miracle" antibiotics. According to this authority, there are few materials, if any, with such unusual diversity in their medical uses.

Essential to Growth, Metabolism

Methionine is necessary for growth, repair and metabolism of all human and animal tissue. Chemically it is DL-2-amino-4-(methylthio) butyric acid.



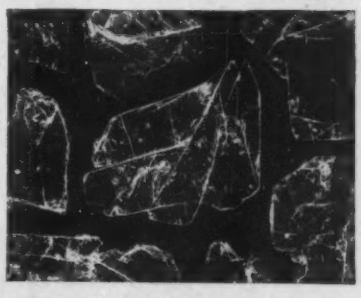
Much of its versatility is attributed to the carbon-sulfur linkage and the labile methyl group. Newer techniques in biochemical research have brought out some of the following characteristics:

- ... Aids in converting dietary protein to tissue protein
- ... Maintains nitrogen balance
- ... Participates in sulfur metabolism
- ... Has trans-methylation activity
- ... Is a precursor of bile acids and improves liver function
- ... Helps rebuild damaged kidney tissue
- ... Speeds wound healing
- ... Helps overcome adverse effects of stress factors such as temperature extremes, disease, overmedication, etc.
- ... Increases antibody production
- ... Acts as a detoxifier, overcoming effects of many toxic compounds due to accidental ingestion, overmedication, tissue injury, heavy metals, etc.
- ... Helps hormone activity

Many Pharmaceutical Applications

Methionine is valuable for its detoxifying properties and for preventing fatty infiltration of the liver. It has been used in formulas in

MORE



Crystals of DL-Methionine as seen under a microscope.

Ammonia Ups Efficiency of Lube Oil Refining

Where lube oil feed stocks run high in undesirable naphthenic acids, satisfactory removal by the usual solvent extraction method becomes highly uneconomical. An excessive amount of solvent must be used. Yields are cut.

According to a recent patent, the problem is now being solved by the addition of ammonia to the solvent-oil system. Neutralization numbers—measures of naphthenic acid content—have been reduced to well below the acceptable 0.1mg. KOH per g. of oil, where values up to 0.2 had previously been obtained. Ammonia is used in amounts below one percent based on the volume of oil.

This is one of several new industrial uses for ammonia that have been revealed within the past few months. Year-round applications of this kind help to smooth out the extremely seasonal fertilizer demand curve which has caused concern to ammonia manufacturers anxious to maintain uniform production levels from month to month.

Right now U.S.I. and other ammonia producers are filling storage facilities left empty by the just-completed fertilizing season.

Sodium-Butadiene Reactions Produce New Chemicals

Buna rubber derives its name from a **BU**tadiene-**Na** reaction developed in England and Germany simultaneously, and industrially important in Germany during the late 1920's. Inability to obtain high sodium surface area at that time resulted in poor control and led to a change in the process.

Today new butadiene-sodium reactions are reaching commercial importance. One reason for this renewed interest has been the development by U.S.I. of sodium dispersions—stable suspensions of microscopic sodium particles in inert hydrocarbon media. This new form permits controlled reaction temperatures, increased yields and decreased side reactions.

Recent patents have been issued covering new butadiene-

MORE

July-Aug. ★ **U.S.I. CHEMICAL NEWS** ★ 1955

CONTINUED

Methionine

dermatology and cosmetics and has been found effective for treatment of acne and falling hair. Addition of methionine to infant formulas has been found helpful in overcoming diaper rash. Pediatric experience has shown that daily additives of 180 milligrams of methionine to infant formulas have produced optimum gains in weight. This has led progressive manufacturers to use it in specialized supplements for young children. It is also an important metabolite in geriatric preparations. Oral ingestion of methionine has been reported effective in removing warts. It has improved the ability of the eye to become adjusted to night vision, an effect found to last from 24 to 32 hours. Methionine has been found valuable in the treatment of obstetric complications associated with liver damage of the mother and newborn often due to Rh incompatibility.

Essential in Healing

Trace studies with "tagged" compounds have proved that methionine plays an essential role in the synthesis of connective tissue and increases the rate of wound healing. Topical application of N-acetyl DL-methionine has helped in healing varicose leg ulcers which had not responded to other treatment.

Aids in Metabolic Balance

Nitrogen retention studies show that metabolic balance is affected by methionine. This compound has been more effective than Vitamin B_{12} for promoting weight recovery following protein starvation. Methionine reportedly assists in restoring normal metabolism after experimental overdoses of thyroid hormone. Other experiments indicate that certain liver disorders and anemia can be alleviated by adding methionine to the diet. It has been tested and found effective for reduction of blood cholesterol levels. Methionine aids hormone activity and, according to recent reports, injection of methionine has produced significant response in experimental animals.

Necessary in Animal Feeds

Feed manufacturers add methionine to various rations for increased growth and feed efficiency. Methionine in dog food formulations makes more of the protein in the ration available for growth and maintenance of health.

It has recently been reported that a direct relationship exists between methionine requirements and the energy level of the diet. Such a direct relationship is of great importance in formulation of high energy rations. Price reductions of feed grade methionine in the last few years have made it even more practical to include optimum amounts of methionine in manufactured feed.

Alcohol Injections To Brain Curing Parkinsonism

A New York doctor has devised an operation using absolute alcohol to relieve the uncontrollable tremor of Parkinson's disease. He inserts a plastic tube into the gray matter of the brain and injects procaine, which should check the tremor temporarily. If it does, he is sure the right spot has been reached, and absolute alcohol is then injected to do the job permanently. Of the first few cases, more than half have been free of symptoms for many months now.

Alcohol has been widely used as a nerve blocking agent and for many other medical and pharmaceutical applications. The new operation adds another to its varied functions as a medical tool.

CONTINUED

Sodium

styrene copolymers prepared with a dispersed sodium catalyst. Products based on these patents are now being marketed in the form of oils which can be converted to resinous materials at elevated temperatures. The recently announced U.S.I. Isosebacic* acid is made by still another reaction between butadiene and sodium.

*Trade Mark

TECHNICAL DEVELOPMENTS

Information about manufacturers of these items may be obtained by writing U.S.I.

Flaws on metal surfaces are being located by means of a penetrating red dye followed by a white developer which pulls the hidden penetrant to the surface, giving a red on white evidence of imperfections. **(No. 1100)**

Porous aluminum with uniformly ultra-fine pore size is now made by a unique powder metallurgy process. The material, with pore openings ranging from 5 to 150 microns, can be used as a filtration and gas dispersion medium. It is formed and welded readily. **(No. 1101)**

A new type heavy-gage polyethylene liner for steel containers is available for installing as an integral part of the container during production. Electronically sealed, with closed top, the liner makes possible liquid shipping at reduced costs. **(No. 1102)**

Odorless paints with excellent resistance to acids, alkalies and cleansers are now produced for food and other plants where odors hamper manufacture. They contain an odorless solvent specially distilled from petroleum. **(No. 1103)**

New products control static electricity during microscopic and analytical work and in the laboratory where flammable solvents are used. Small quantities are applied to synthetic textile clothing; and to surfaces in general. **(No. 1104)**

An acrylate-type elastomer has been developed with high resistance to petroleum and chemical hydraulic fluids and to ozone. It is recommended for hydraulic packings, hose liners, wire coatings and fabric impregnants. **(No. 1105)**

Two new radioactive carbon-14 compounds are now available commercially. They are cetyl-1-C-14 and stearyl-1-C-14 alcohols, useful for tagged detergent and metabolic studies. **(No. 1106)**

A thin protective coating for metal parts and assemblies has been developed to replace heavy viscous types. It provides maximum corrosion protection and moisture repellency, plus lubrication. **(No. 1107)**

A new liquid laundry rinse reduces static and repels dirt. When added to final rinse water, the positively charged liquid attached to negatively charged fibers, makes clothes soft, fluffy and dirt repellent. **(No. 1108)**

A new vinyl chloride extrusion compound contains a non-migratory type of plasticizer and a specially selected fungicide. It was developed specifically for the extrusion or molding of vinyl parts which must contact styrene. **(No. 1109)**

PRODUCTS OF U.S.I.

ALCOHOLS
- Butanol (Normal-Butyl Alcohol)
- Fusel Oil — Refined

Ethanol (Ethyl Alcohol)
- Specially Denatured—all regular and anhydrous formulas
- Completely Denatured—all regular and anhydrous formulas
- Pure—190 proof U. S. P., Absolute—200 Proof
- Filmex*—special proprietary solvent
- Solox*—proprietary solvent—regular and anhydrous

ETHERS
- Ethyl Ether, U. S. P.
- Ethyl Ether, Absolute—A.C.S.

ACETONE—A.C.S.

ANSOLS
- Ansol* M
- Ansol* PR

ACETIC ESTERS
- Butyl Acetate
- Ethyl Acetate—all grades
- Normal-Propyl Acetate

OXALIC ESTERS
- Diethyl Oxalate

OTHER ESTERS
- Diatol*
- Diethyl Carbonate

INTERMEDIATES
- Acetoacetanilide
- Acetoacet-ortho-chloroanilide
- Acetoacet-ortho-toluidide
- Acetoacet-para-chloroanilide
- Ethyl Acetoacetate
- Ethyl Benzoylacetate
- Ethyl Sodium Oxalacetate

FEED PRODUCTS
- Calcium Pantothenate (Feed Grade)
- Choline Chloride Products
- Curbay B-G* 80
- DL-Methionine (Feed Grade)
- Niacin, U.S.P.
- Riboflavin Concentrates
- Special Liquid Curbay*
- U.S.I. Vitamin B_{12} and Antibiotic Feed Supplements
- Vacatone* 40
- Vitamin A, D_2, and K_3 Products

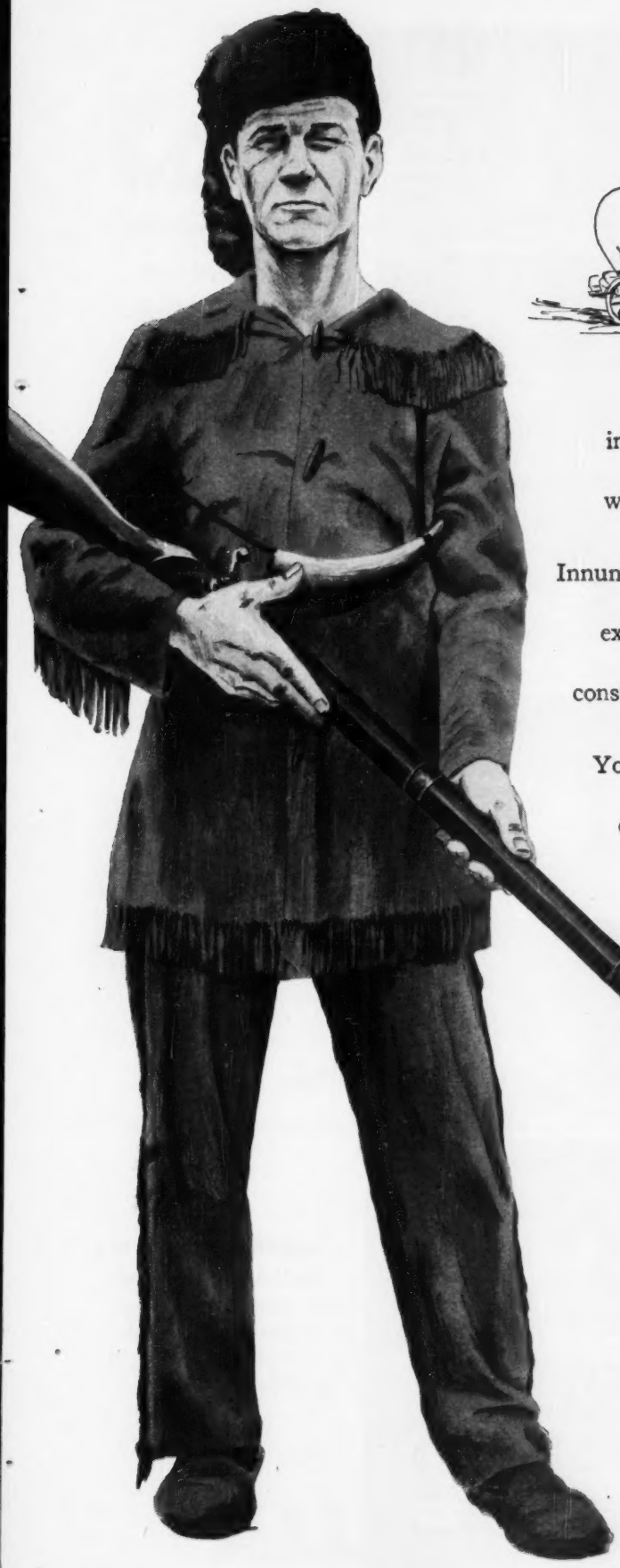
PLASTICS
- Petrothene** Polyethylene Resins

OTHER PRODUCTS
- Anhydrous Ammonia
- Caustic Soda
- Ethylene
- Liquid Chlorine
- Metallic Sodium
- DL-Methionine (Pharm.)
- N-Acetyl DL-Methionine
- Nitrogen Solutions
- Propionic Acid
- Riboflavin U.S.P.
- Sulfuric Acid
- Urethan, U.S.P.

*Reg. U.S. Pat. Off.
**Reg. Pend.

U.S.I. INDUSTRIAL CHEMICALS CO.
Division of National Distillers Products Corporation

99 PARK AVENUE, NEW YORK 16, N. Y. BRANCHES IN ALL PRINCIPAL CITIES



LEADING THE WAY

As they traveled through unfamiliar regions in their prairie schooners, the pioneer settlers of the western regions of America were faced with many uncertainties. For them, the journey was truly a voyage into the unknown.

Innumerable doubts and misgivings can be present, too, when you embark on an important expansion program, particularly when a decision must be reached on the selection of a process construction organization. There can be no turning back after the commitment becomes final.

You will be free of this concern when you choose Procon, with its complete design, engineering, and construction facilities. Procon has repeatedly demonstrated its leadership in completing a wide variety of projects according to the specified requirements.

Our engineering staff can show you in detail why your next process construction job should be handled by Procon.

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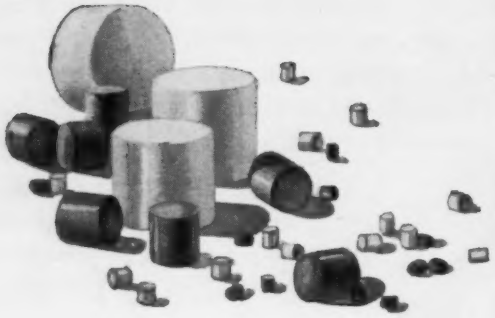
PROCON®

HARSHAW'S

Continuous Research Develops

stronger *tableted* catalysts



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Taken at 1/20,000th of a second, the pictures show a Harshaw catalyst tablet being tested for strength—one step in our research program designed to produce more efficient tableted catalysts having the highest useful strength. Our goal, of course, is to make the catalyst you want and need. First you specify, and then we produce.

Tougher, more efficient catalysts mean fewer reactor shutdowns, and, naturally, more economic operation for you. Harshaw Catalysts mean fewer reactor shutdowns.

If your mind's on catalysts please contact us today by phone or letter.

HARSHAW CATALYSTS
available in these forms:

Tablets	Powders
Extrusions	Spheres
Granules	Rings
Flakes	

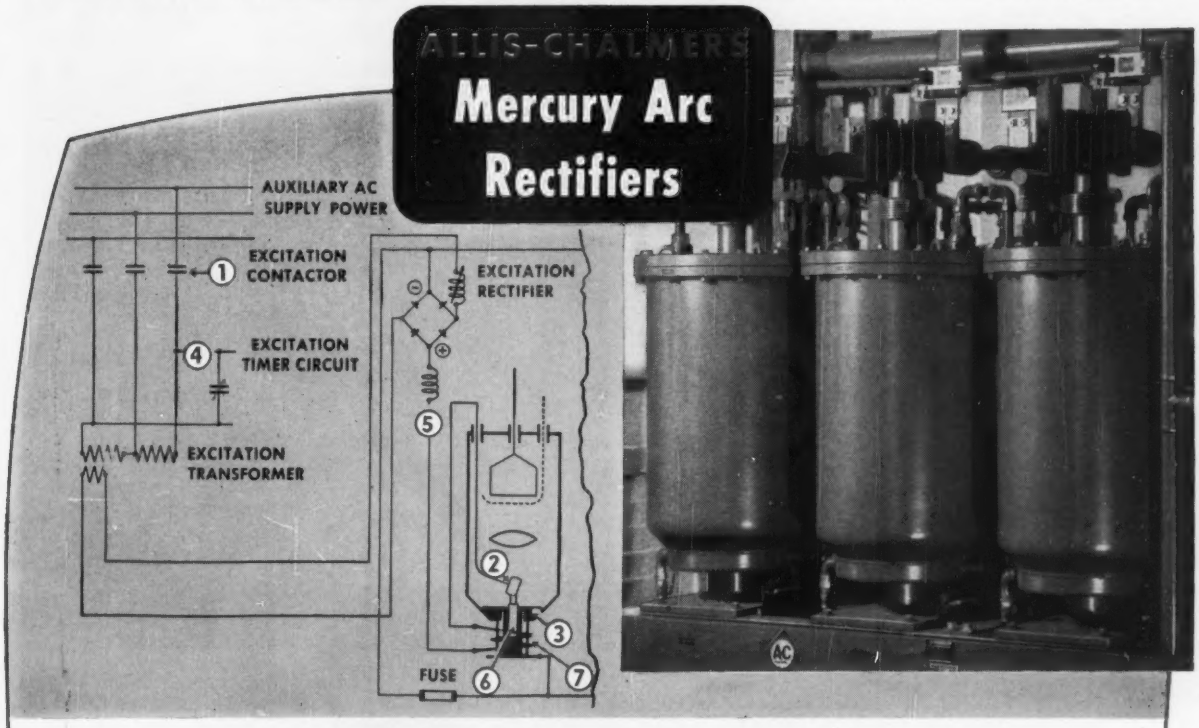
For Reliable Rectifier Operation Get

Continuous Excitation

Allis-Chalmers excitron rectifiers eliminate the need for a pulse-type firing system timed for operation every cycle. Maintenance is easy because of the simplicity of design.

A small dc excitation arc is automatically ignited only once, when the unit is started, and then maintained on the mercury cathode of each rectifier tube. It offers advantages similar to a pilot light. Since it is far easier to maintain an arc than to start it, this feature makes the excitron far less likely to lose excitation during power supply disturbances than other types of rectifiers.

Get all the facts about excitron rectifiers before your next installation. Call the A-C office nearest you or write Allis-Chalmers, Milwaukee 1, Wisconsin.



Supply of DC Provides Key to Continuous Excitation

Direct current supplied from excitation rectifiers is the key to continuous excitation. When the excitation system is energized by means of a contactor (1), positive dc potential appears on the excitation anode (2) of each tube, negative at the cathode (3). A timer (4), through contacts of the excitation failure relay (5), is energized at the same time.

As soon as voltage is applied, current flows from the anode to the cathode through the ignition plunger (6). This current energizes the ignition coil (7) and causes the plunger to be pulled below the mercury surface. As the plunger travels down, an arc is drawn which transfers from the graphite tip of the plunger to the mercury. This current flow keeps the coil energized, maintaining a continuous arc.

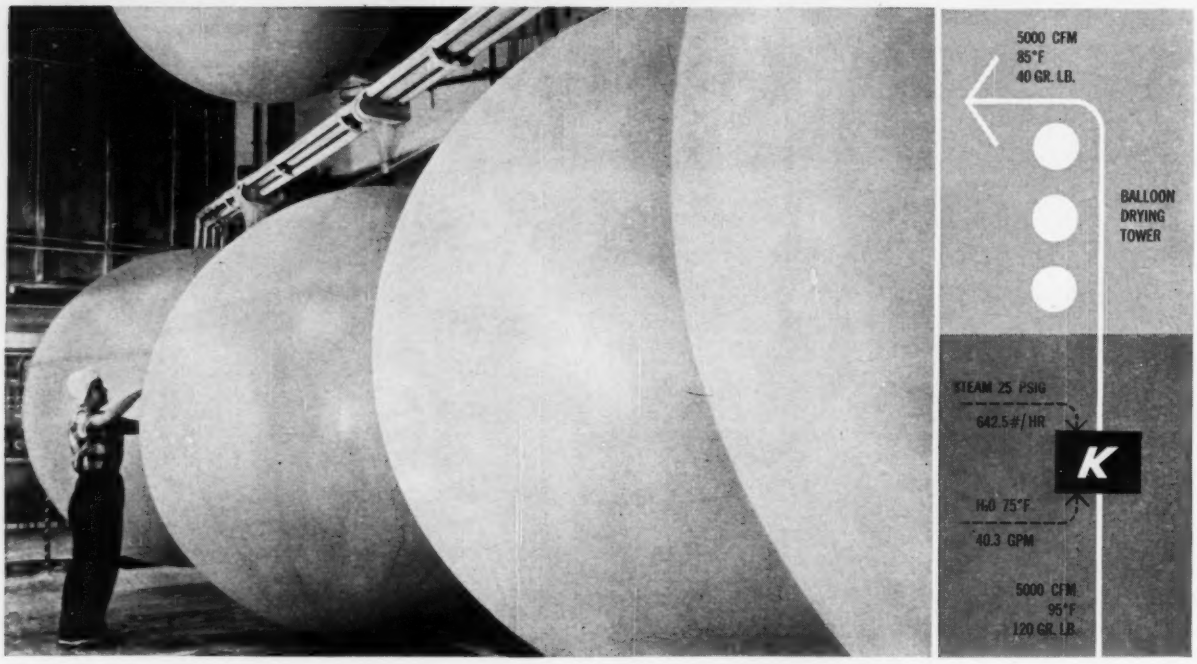
If excitation failure should occur while the rectifier is carrying load, the plunger is released, floating upward in the mercury until it makes contact with the anode, then repeating the process above until the arc is re-established.

Re-establishment of the arc as outlined takes less than a second — it does not interfere with normal operation.

ALLIS-CHALMERS

A-4592

Dry air saves balloon-maker $2500/yr.



Low-temperature dry air saves the Dewey and Almy Chemical Company $2500 or more a year in operating costs. Kathabar humidity conditioning delivers this air for drying weather balloons (see flow diagram) using only 75°F city water and low pressure steam. Dewpoint of the air is reduced from 72.5°F to 43°F without refrigeration!

Compared with standard refrigeration for the same operation, the Kathabar system saves 81¢ an hour in water, steam, and electricity requirements—operating savings of over $6 per 8-hour day! In addition, the first cost of Kathabar equipment is lower, operation and maintenance are simpler.

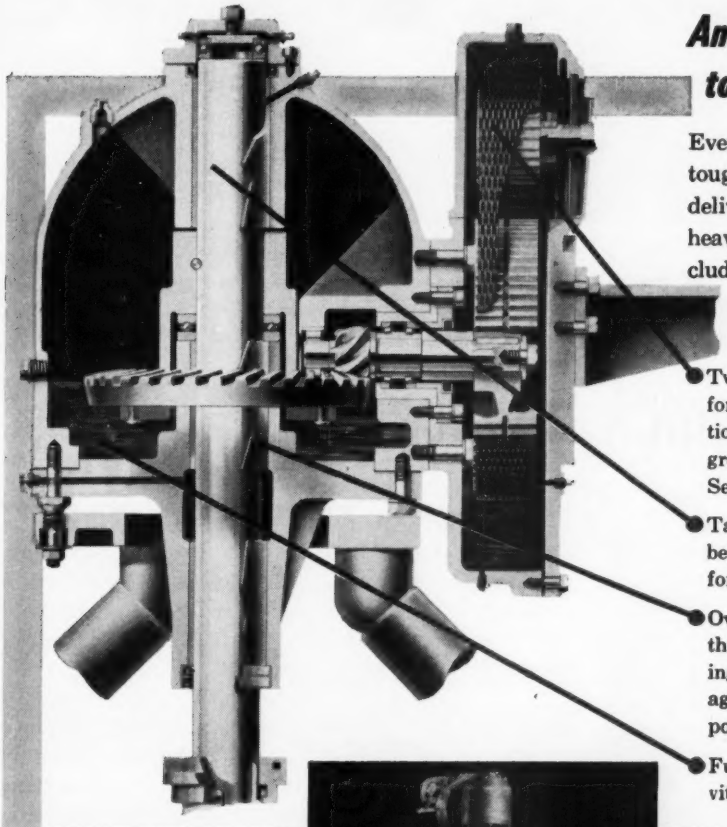
If your operations require low-temperature drying, it will pay you to investigate the many economies of Kathabar humidity conditioning.

write for the complete Dewey & Almy story today

Kathabar®
HUMIDITY CONDITIONING

SURFACE COMBUSTION CORPORATION, TOLEDO 1, OHIO

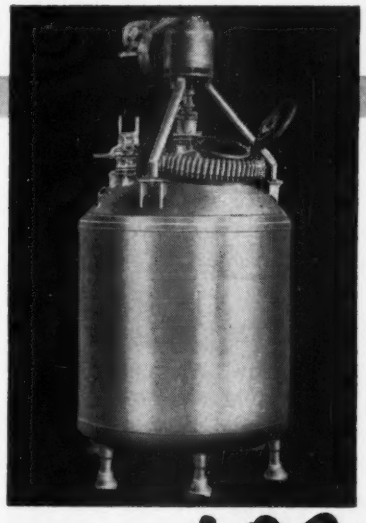
Glascote reactors give you drives that excel in heavy-duty operation



Another good reason why it pays to do business with Glascote

Every unit in Glascote's complete line of tough, precision-engineered drives is built to deliver remarkable dependability in your heavy-duty applications. These drives include V-belt types for laboratory reactors . . . variable-speed and gear-head motor drives.

- Two drive reductions transmit ample power for all agitator needs and speeds. First reduction is accomplished by hardened, precision-ground, spiral-bevel pinion and ring gears. Second is made by silent chain or helical gear.
- Tapered roller bearing and a radial roller bearing assure friction-free straddle-mounting for pinion shaft.
- Oversize vertical sleeve bushing and ball thrust bearing support the ring gear, mounting and agitator shaft. Positive alignment for agitator shaft assured by bushings at three points.
- Full bath lubrication means long life for all vital parts.



Equipped with dependable drives, Glascote reactors are available in a selection of sizes for laboratory, pilot plant and production applications. Your choice of glass-lined or alloy metals.

Ask the representative who calls on you for all the facts about Glascote products—reactors, receivers, condensers, evaporators, storage tanks and accessory products. Or, if you prefer, write direct. Glascote Products, Inc., Cleveland, 17, a subsidiary of A. O. Smith.

Glascote

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CLEVELAND 17, OHIO

Sales offices or agents in Principal Cities

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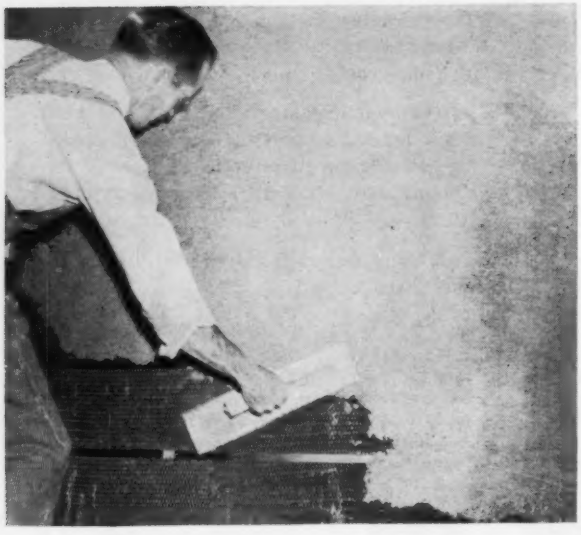
World's largest manufacturer of glass-lined steel products

EAGLE-PICHER

ONE-COTE CEMENT

INSULATES, PROTECTS, FINISHES, in one quick application!



ONE QUICK APPLICATION saves time, work and money. Eagle-Picher One-Cote Insulating Cement is clean, easy to handle—provides a smooth, light-reflectant surface. Just trowel it on *hot or cold* equipment—even *irregular* areas where application of other insulations is often impractical.

ONE QUICK APPLICATION assures a highly efficient insulating job that is effective at temperatures up to 1000F. In outdoor installations, quick-setting One-Cote Cement withstands rain and moisture two hours after application. When used indoors, you need no wire mesh or finishing treatment.

ONE QUICK APPLICATION gives you a fast-setting, rust-inhibitive combination that insulates, protects and finishes. One-Cote Cement spreads easily, gives exceptional coverage and is amazingly efficient.

WRITE FOR FREE SAMPLE TODAY!

Prove to yourself, on your own equipment, how Eagle-Picher One-Cote Cement can save you time, money and valuable man-hours!

Since 1843

EAGLE EP PICHER

THE EAGLE-PICHER COMPANY

Producing a complete line of industrial insulations

Cincinnati 1, Ohio

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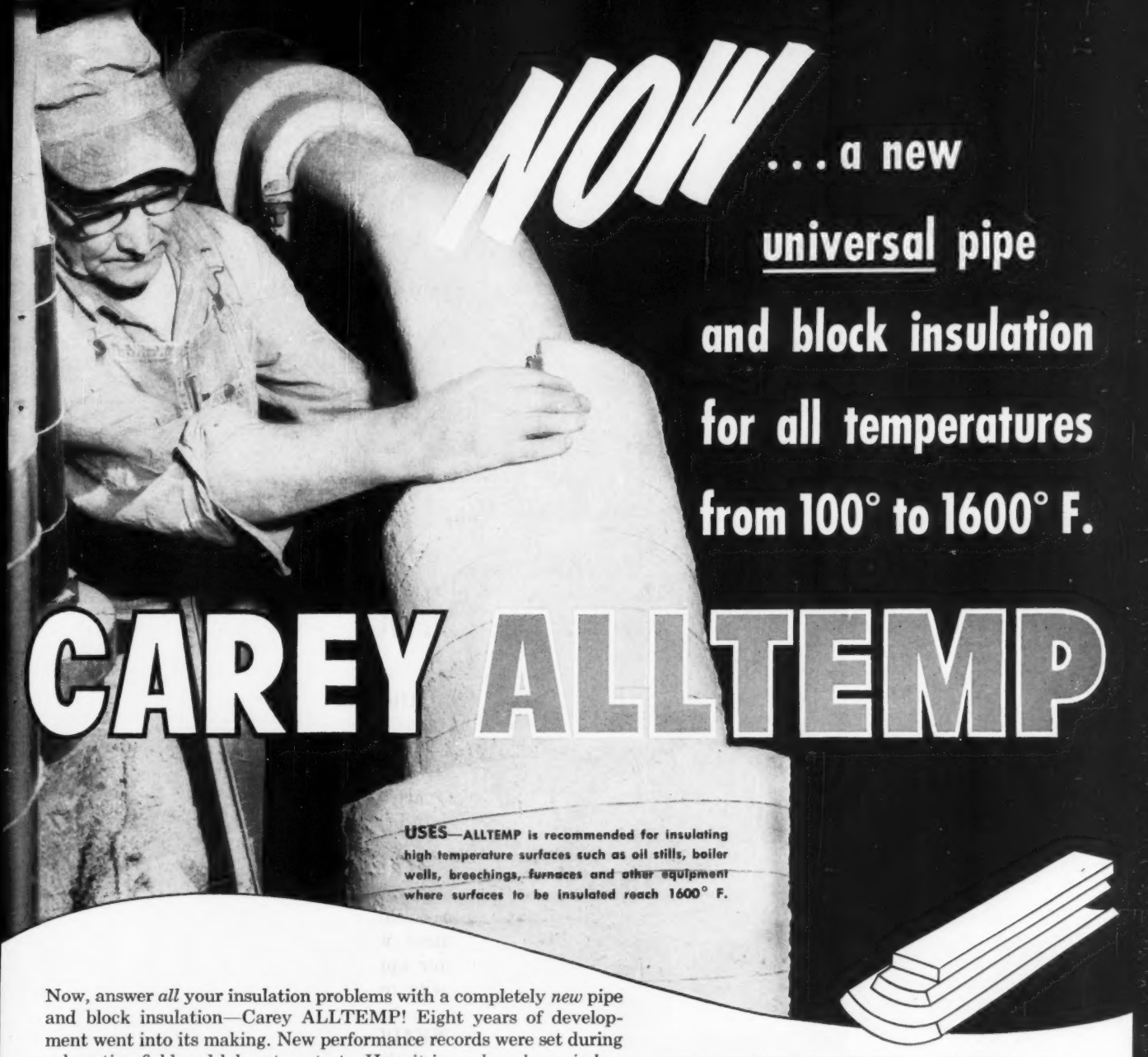

NOW . . . a new universal pipe and block insulation for all temperatures from 100° to 1600° F.

CAREY ALLTEMP

USES—ALLTEMP is recommended for insulating high temperature surfaces such as oil stills, boiler walls, breechings, furnaces and other equipment where surfaces to be insulated reach 1600° F.

Now, answer *all* your insulation problems with a completely *new* pipe and block insulation—Carey ALLTEMP! Eight years of development went into its making. New performance records were set during exhaustive field and laboratory tests. Here it is—*a brand-new industrial insulation* for all temperatures up to 1600° F.

ALLTEMP keeps every last BTU on the job producing power. Its extremely low percentage of shrinkage—approximately ⅔ *less* than other 1200° F. insulation materials—means joints won't open, cracks won't appear in covering. BTU's are *locked in!* ALLTEMP retains its high thermal efficiency and structural strength even after long, continuous exposure to excessive heat and moisture. Non-brittle, it resists blows, abrasions; won't crack or crumble under severe service conditions. And it's easy on the hands—easy to cut, fit, install!

Get all the cost-saving facts on new ALLTEMP today and your copy of the Carey ALLTEMP specification folder.

Just address coupon below.

ALLTEMP RECOMMENDED THICKNESS

Nominal Pipe Size Inches	Temperature Difference °F 80° Air					
	200	400	600	800	1000	1200
	Nominal Thickness, Inches					
1½ & Under	1	1	1½	2	2½	3
2	1	1½	2	2½	2½	3
2½	1	1½	2	2½	3	3½
3	1	1½	2	3	3	3½
3½	1	1½	2	3	3½	3½
4	1	1½	2½	3	3½	4
4½	1½	2	2½	3	3½	4
5	1½	2	2½	3	3½	4
6	1½	2	2½	3½	4	4½
7	1½	2	2½	3½	4	4½
8	1½	2	3	3½	4	4½
9	1½	2	3	3½	4½	5
10	1½	2½	3	4	4½	5
11	1½	2½	3	4	4½	5
12	1½	2½	3	4	4½	5
14 & Over	1½	2½	3½	4	4½	5½

ALLTEMP is available in clean, easy-to-handle flat and preformed blocks. "Nesting" O.D. pipe covering sizes provide accurate, tight fits for multiple layer construction. Only a limited number of "prime" units are necessary for unusual assemblies.

Better Products for Industry Since 1873

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Carey-approved contract units in major trading areas. Consult your nearest Carey District Office or your Telephone directory.

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Please send free illustrated folder showing specifications, installation details and complete facts on new ALLTEMP insulation.

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NEW Advanced Design...

NEW HIGH SUSTAINED ACCURACY . . .
even under extreme operating and ambient conditions

NEW CONVENIENT ZERO ADJUSTMENT . . .
external—no need to remove weather-proof cover

FACTORIES IN THE UNITED STATES, CANADA AND ENGLAND

d/p Cell Flow Transmitter...

NEW POSITIVE OVERRANGE PROTECTION . . . up to full 1500 lbs. cell rating

6 Major Achievements!

NEW FULLY ADJUSTABLE RANGE . . . from 0-50" to 0-250" H_2O differential

NEW AUTOMATIC INTERNAL DAMPING . . . fast, stable measurement

NEW SIMPLICITY . . . lowest cost installation

Pioneered by Foxboro 7 years ago, the d/p Cell* Transmitter established a new standard of performance in flow measurement and control. Over 40,000 are maintaining that standard in every branch of industry today. Technical advances, based on this unequalled experience, now have added even further reliability, economy and convenience. Call your Foxboro representative for a demonstration. Write for new Bulletin 13-11.

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first in flow measurement

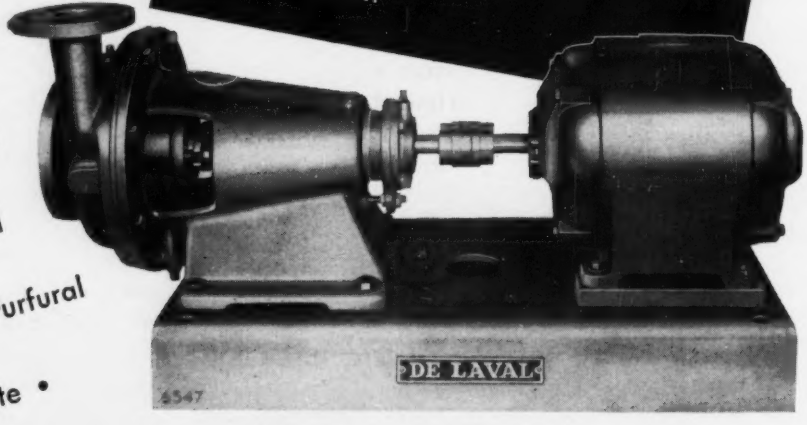
THE FOXBORO COMPANY, 368 NEPONSET AVE., FOXBORO, MASS., U.S.A.

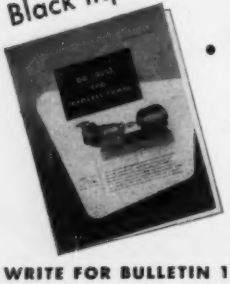
• Calcium chloride brine • Flushing liquor • Sodium sulphate • Asbestos fiber & cement mix • Green liquor • Soap solution • Grinder coolant • Carbon slurry • Cane wash • Salt brine • Sea water • Caustic solution • Bleach liquor • Grape juice concentrate • Tomato juice concentrate • Tomato puree • Propanol • Soap liquor • Cane juice • Aqueous lime • Coke oven oil • Paper stock • Waste sulphite liquor • Alkylaryl sulfonate • Sugar liquor • Vinyl pyridine • Saturated brine • Grape juice • Tomato juice • Press liquor • Calcium bisulphite • Melt Phenolized ammonia • Ammonia liquor • Sulphuric acid • Paraffine oil and water • Sludge • Milk waste • Gritty water • Cane syrup • Lime & soda solution • Cachaza • Clear juice Cement • Gasoline • Depanol White water • Mineral oil • Chromic acid Flume water • Brine • Vegetable oil • Licorice liquor • River water • Benzine thinner • Mash Methylene chloride • Sodium hydroxide Sizing solution • Alcohol • • Steep soda • Caustic soda Black liquor • Ethylene glycol • Fuel oil • Furfural • Condensate •

One pump handles all these liquids...

DE LAVAL CPO PROCESS PUMP

CAPACITIES TO 2,000 GPM
HEADS TO 200 FT.





WRITE FOR BULLETIN 1125-B

DE LAVAL *Centrifugal Pumps*

DE LAVAL STEAM TURBINE COMPANY
803 Nottingham Way, Trenton 2, New Jersey

DL 281

Planning Some Big Ones Like This?

Fully assembled, this forged converter weighs in the neighborhood of 150 tons. It has an inside body diameter of almost 4 ft. Every component has been machined to precise tolerances, and all have strength that is far beyond actual needs.

It is a big vessel, one of the many sizes and types that Bethlehem makes each year. If you are planning something of this nature, we can offer you a fully integrated service—one that begins with the making of the steel and carries through all the steps of forging, treating, machining, assembling, and testing.

Bethlehem forged pressure vessels are seamless units made with any desired thickness of wall. They can be furnished in either carbon or alloy steel, the choice of analysis being determined by customer needs. Each vessel is subject to exhaustive metallurgical checks, and it is tested hydrostatically at specified pressures.

Call us whenever you are considering new autoclaves, reactors, converters, separators, filters, accumulators, or other types of forged vessels. Bethlehem shops are equipped to handle any specifications you write, and our engineers will work in complete accord with your own.

BETHLEHEM STEEL COMPANY, BETHLEHEM, PA.

On the Pacific Coast Bethlehem products are sold by Bethlehem Pacific Coast Steel Corporation. *Export Distributor:* Bethlehem Steel Export Corporation

BETHLEHEM STEEL

BETHLEHEM STEEL

when Time is important in handling dry materials in bulk

. . . call on Fuller

. . . . pioneers in harnessing AIR

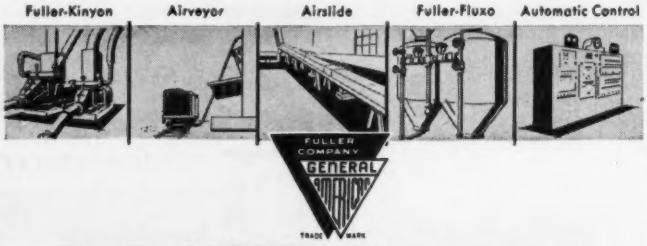
Time *is industry's most important asset.*

When time is used wisely, the more time you save, the more money you make.

Put a stop-watch on every step in your present handling of dry materials in bulk (a non-productive but essential function.) You'll probably agree it could be better, much better.

If so, don't shudder. Instead, get in touch with Fuller, who will be glad to make a realistic appraisal of your materials handling problem. Be sure to ask for Fuller's interesting brochure called "How to Pull Dollars Out of Thin Air."

Depending on the materials involved and your plant layout, there's a fine combination of Fuller systems (Fuller-Kinyon, Airveyor, Airslide, Fuller-Fluxo,) best suited to save your time and temper, improve your efficiency and your outlook.



Fuller

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FULLER COMPANY, Catasauqua, Penna.

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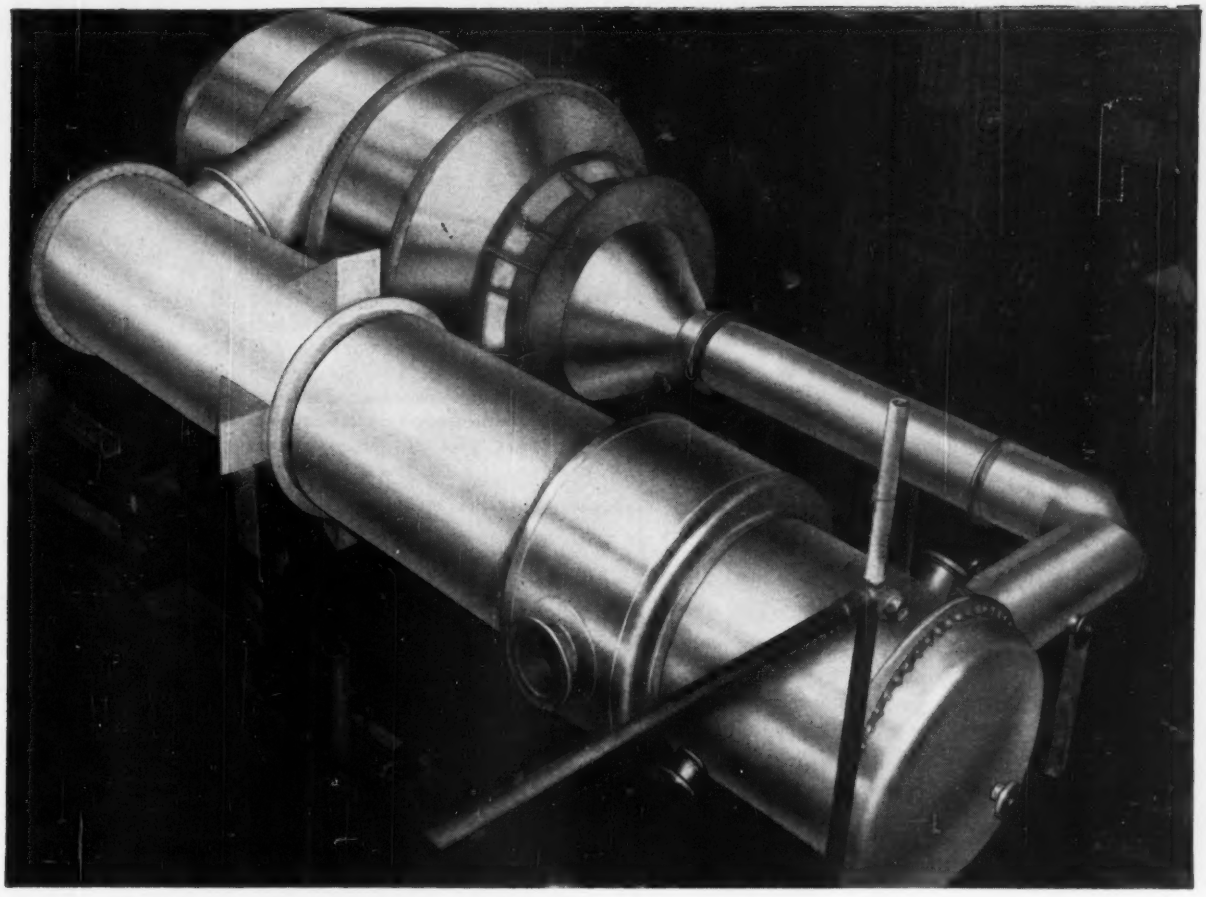


Why STAINLESS STEEL is best for processing Glacial Acetic Acid

This special type calandria evaporator processes glacial acetic acid. Yet its vital parts—tubes . . . liquid and vapor heads . . . downleg and centrifugal separator—are almost indestructible in this service. That's because they're fabricated of Crucible stainless steel, type 316.

The fabricator, Badger Manufacturing Company, chose type 316 stainless because it is one of the best known alloys for handling acetic acid. It is completely resistant to acetic acid in all concentrations, and under the majority of pressure and temperature conditions. And, most important, stainless steel does not contaminate glacial acetic acid.

Its *physical* properties make stainless a wise choice, too. Its high tensile strength means minimum structural support. Its practical workability permits forming complex sections without undue trouble. And these sections are readily welded, since type 316 is designed to inhibit the precipitation of harmful carbides on cooling from high temperatures.

If you're concerned with the manufacture or use of chemical processing equipment, check the advantages offered by the 30 available types of Crucible stainless steel. Your nearby Crucible representative will be glad to give you more details. Or, for an over-all look at the many uses of stainless, write for "Making the Most of Stainless Steels in the Chemical Processing Industry." *Crucible Steel Company of America, The Oliver Building, Mellon Square, Pittsburgh 22, Pa.*

CRUCIBLE first name in special purpose steels

Crucible Steel Company of America

Let Dings help you select the MAGNETIC SEPARATOR that will best meet your specific requirement

● Why not eliminate guess-work from magnet selection? To assure a successful installation, it is simply a matter of choosing exactly the right magnet for the job.

At Dings, "job-selecting" a magnet can be done on an ideal basis because Dings, and only Dings, offers these three things: (1) the widest line of types and sizes available; (2) unsurpassed quality of materials and magnetic engineering; (3) OVER 50 YEARS' EXPERIENCE IN THE DESIGN, MANUFACTURE AND APPLICATION OF EVERY CONCEIVABLE TYPE OF MAGNETIC SEPARATOR. Whatever your magnetic separation problem, these are the advantages you get when you buy a Dings "Job-Selected" magnet.

Shown on this page are but a few of the wide range of Dings Magnetic Separator types now available. Clip and mail the coupon for further information.

DINGS MAGNETIC SEPARATOR CO.
4730 W. Electric Ave.
Milwaukee 46, Wis.

Please send copy of Catalog C-5000-B.

Name_____ Title_____

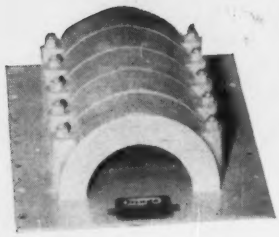
Company_____

Address_____

City_____ Zone____ State_____

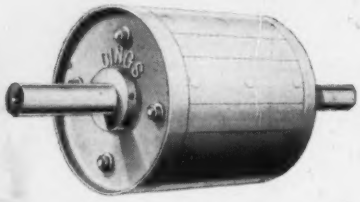
AD155

PERMA-PLATES



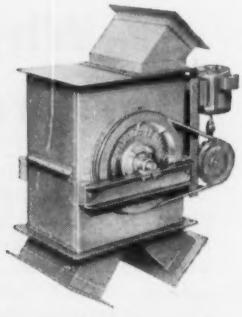
Use these non-electric magnets for installation in steel or wood chutes or spouts or above belts. Use Type 1 when depth of material does not exceed 1"; Type 2 for burden depths to 2"; Type 3 for burden depths to 3". Available with two poles for standard service and four poles for maximum protection on difficult jobs. All sizes. *Here is the lowest cost answer to your tramp iron removal problems!*

PERMA-PULLEYS



Install as a non-electric head drive pulley in belt conveyor systems. Completely automatic removal and discharge of iron. Extremely powerful. Meets all requirements. Complete range of sizes.

PERMA-DRUMS



Install bare drums at the discharge of spouts or chutes; fully enclosed models can be installed in closed chutes for completely dust tight installations. Highest grade Alnico. More powerful than old electro-drums. Fully automatic removal and discharge of iron. Complete range of sizes.

Dings

DINGS MAGNETIC SEPARATOR CO.

4730 W. Electric Ave. • Milwaukee 46, Wis.

Magnetic Separation Headquarters Since 1899

THE ONLY FLUED-DOME TANK CAR MADE OF HEAVY GAUGE STEEL!

Flued dome section.

Flued dome construction . . . heretofore possible only with special aluminum cars . . . is now available in *all* tank cars designed and built by acf. This development is the result of advanced engineering and a gigantic million-dollar press—capable of forming the dome base from an entire top center section of heavy gauge *steel*. So whatever your tank car requirements are, specify DURADOME and you get flued dome benefits *at no extra cost!*

Contact your Shippers' representative for details about buying or leasing the new DURADOME. He'll give you the facts about DURADOME'S *pressure-type construction, standardized underframe, all-welded insulation jacket* and the many benefits of *flued-dome* construction.

Specialists for over 35 years in the leasing, operation, maintenance and servicing of tank car fleets—now exclusive sales agent of acf tank cars for industry.

SHIPPERS SHPX CAR LINE

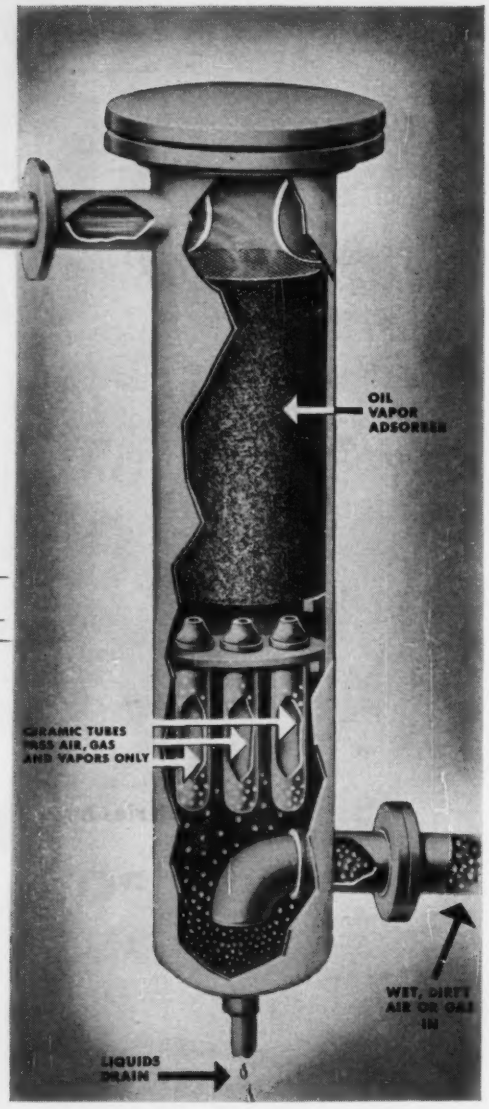
Shippers' Car Line Corporation

A subsidiary of acf INDUSTRIES, Incorporated

30 Church Street, New York 7, N.Y.

CHICAGO, ILL. • HOUSTON, TEX. • SAN FRANCISCO, CAL. • MILTON, PA. • EAST ST. LOUIS, ILL. • SMACKOVER, ARK. • TULSA, OKLA. • NORTH KANSAS CITY, MO.

AUTOMATIC PROTECTION
for
AIR AND GAS SYSTEMS


AIR OR GAS FREE OF LIQUIDS, DIRT AND OIL VAPOR
OIL VAPOR ADSORBER
CERAMIC TUBES PASS AIR, GAS AND VAPORS ONLY
WET, DIRTY AIR OR GAS IN
LIQUIDS DRAIN

SELAS
VAPE-SORBER

CONTINUOUSLY REMOVES
PETROLEUM VAPORS, DIRT AND LIQUIDS FROM AIR AND GASES

Its double action removes water, oil, emulsions and dirt with liquid-impervious ceramic filters which freely pass air without significant drop in pressure. Petroleum vapors are then removed by adsorption. Result: conditioned air and gases for maximum instrument accuracy and process efficiency.

Numerous critical processes . . . including liquid aerations and agitations . . . compressed air for drying and cleaning . . . instruments and pneumatically operated mechanisms . . . rely on the Vape-Sorber for clean air or gas.

Selas Vape-Sorbers are built to last! No moving parts. Filters and chambers are easily cleaned and replaced. No other maintenance necessary.

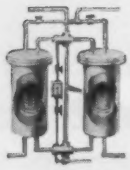
Selas Vape-Sorbers are available in capacities varying from 100 to 5000 scfm, at inlet pressures up to 3500 psi.

Write for new Bulletin SC-1047 "Selas Vape-Sorber," Bulletin SC-1007 "Selas Liqui-Jector" and Bulletin SC-1013 "Selas Dehydrator."

Other SELAS UNITS FOR AIR-GAS PROCESSING

LIQUI-JECTOR

Continuously removes water, water-oil emulsions and dirt particles from air, gas and steam.



DEHYDRATOR

Continuously dries compressed air, carbon monoxide, carbon dioxide, hydrogen, oxygen, gaseous hydrocarbons and inert gases.

SELAS = **FLUID PROCESSING**

CORPORATION OF AMERICA • PHILADELPHIA 34, PA.

2¼-yd. MICHIGAN 175A carries heaping bucket load of ammonium sulfite . . .

This big POWERHOUSE handles bigger jobs cheaper!

Check the specs of the MICHIGAN* 175A:

BUCKET CAPACITY..... 2¼ yds.
WEIGHT..... 24,100 lbs.
LIFTING CAPACITY..... 15,000 lbs.
SPEED . . Up to 27 mph, Forward and Reverse
HORSEPOWER..... 133 Diesel, 126 Gas, 165 Supercharged

Don't look for "comparative" data on the MICHIGAN 175A—there is *no machine comparable.* This big bruiser is nearly 50% bigger than the next closest machine on the market. From flywheel to bucket, the 175A is built to do bigger, heavier jobs—jobs that no other rubber-tired machine can handle.

Better traction and flotation With the MICHIGAN's exclusive power train—300% torque multiplication, power shift transmission (no engine clutch) and planetary wheel axles—you get a shockless flow of power right down to the ground. There's no surge, no wind-up in the axle shaft, no wild wheel-spin. The operator has feather-touch control over his wheels; in weak soil conditions or mud, he can ease off or step up the power to keep from digging in. With this kind of smooth power transmission, you get the full advantage of the MICHIGAN's extra weight and power—you dig material *out*, you don't dig the machine *in*.

Hydraulic power does the work In spite of its size and power, the MICHIGAN 175A is easier to operate than most machines one-third its size. Hydraulic power does all the real work: power steering, 4-wheel power brakes, power-shifting with two simple levers on the steering column, no clutch pedal.

See it in action! We'll prove that the MICHIGAN is in a class by itself in the Tractor Shovel field: your local MICHIGAN distributor will arrange a demonstration—on your own job, if you wish. Or write for 12-page Tractor Shovel booklet containing explanation and cutaway drawings of the MICHIGAN power train. Any MICHIGAN is available on a low-cost Lease Plan—ask for brochure which explains how you can use it.

CLARK EQUIPMENT

CLARK EQUIPMENT COMPANY
Construction Machinery Division
432 Second Street
Benton Harbor 30, Michigan
Phone WA 6-6184

*A Trademark of Clark Equipment Company

WHEN YOU'RE UNDER PRESSURE

ON PRESSURE VESSELS . . .

THIS IS THE KIND OF HELP YOU GET AT KELLOGG . . .

Design Engineering: Kellogg will assume entire responsibility or work closely with your own design engineers on their proposals. Optimum designs are assured either way.

Technical Competence: Kellogg's experience in metallurgy, heat transfer, stress analysis, metal fatigue, corrosion control, is unequalled among pressure vessel fabricators.

Fabricating Techniques: Kellogg fabrication methods are the culmination of 40 years of building pressure vessels to exacting specifications. Many improved techniques have resulted, such as K-Weld*.

Non-Destructive Testing: Kellogg's complete facilities include the company's portable "atomic cameras" which can photograph welded seams up to six inches thick in a single short exposure.

Prompt Delivery: Kellogg's plant modernization program assures faster delivery than ever before. Small and large orders receive the same attention.

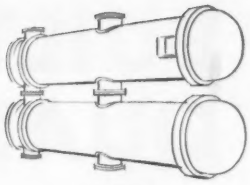
Construction Service: Kellogg's continuing work in erecting vessels for complete oil refineries, pulp mills, and chemical plants provides a fully-staffed construction department with crews that know their jobs.

Guaranteed Performance: Kellogg's reputation has been built on long and efficient product life. The MWK name plate is your guarantee.

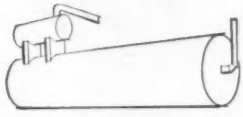
FABRICATED PRODUCTS DIVISION
THE M. W. KELLOGG COMPANY, 225 BROADWAY, NEW YORK 7, N. Y.
In Canada: The Canadian Kellogg Company, Limited, Toronto
In Europe: Kellogg International Corporation, London
SUBSIDIARIES OF PULLMAN INCORPORATED

*Trademark of The M. W. Kellogg Company

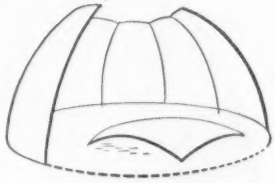
PUT YOUR PROBLEMS UP TO M KELLOGG W



HEAT TRANSFER EQUIPMENT

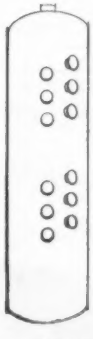


TANKS AND REACTORS



KNOCKDOWN VESSELS

PROCESS PIPING

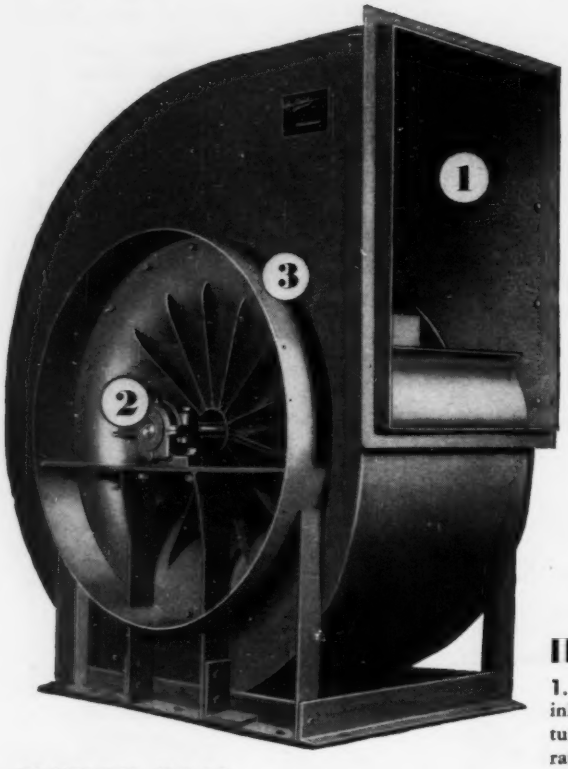


PRESSURE VESSELS

HERE'S THE BUILT-IN QUALITY YOU GET IN THIS "Buffalo" FAN

In October of 1953, when we introduced the "Buffalo" Type BL Limit-Load Ventilating Fan, we knew it offered the finest features for quiet, stable, efficient performance in industrial service. Since that time, it has more than measured up to highest expectations.

A study of the "Q" Factor* features illustrated here will show you *why* this fan will give you your money's worth, and more, in *performance*. Further details in Bulletin F-102, your copy upon request.

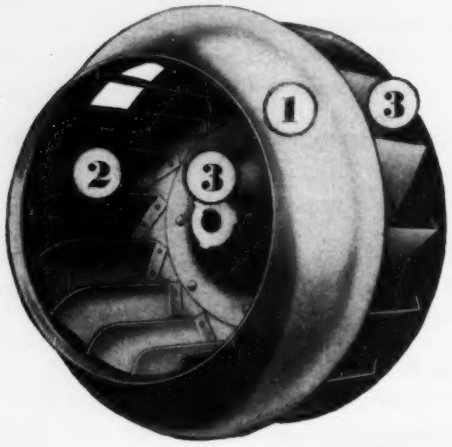


ENTIRE FAN

1. Housing proportioned and streamlined for peak efficiency.
2. Self-aligning bearings; choice of sleeve or anti-friction type.
3. Large, smooth inlet collar for easy duct connection.

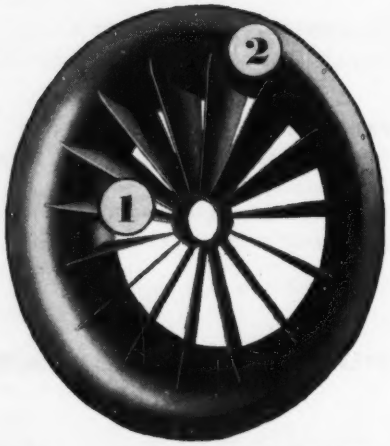
ROTOR

1. Shroud die-formed to full curvature, matching inlet bell, for proper air flow in wheel.
2. Backward *curved blades* for stable air flow. Die-stamped, welded and riveted for maximum strength.
3. Heavy gauge back plate — extra-heavy hub.



INLET

1. Exclusive "Buffalo" inlet guide vanes reduce turbulence and assure full rated delivery, even when inlet conditions are unfavorable.
2. Smooth, die-formed inlet bell matches wheel shroud, further reduces inlet losses.



**The "Q" Factor — the Built-in Quality which provides trouble-free satisfaction and long life.*

"Buffalo"

BUFFALO FORGE COMPANY

501 BROADWAY BUFFALO, N. Y.

PUBLISHERS OF "FAN ENGINEERING" HANDBOOK

Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

VENTILATING AIR CLEANING AIR TEMPERING INDUCED DRAFT EXHAUSTING FORCED DRAFT COOLING HEATING PRESSURE BLOWING

FAMOUS LIGHTHOUSES OF AMERICA

PORTLAND HEAD LIGHTHOUSE, Maine, was built between 1787 and 1790 by two Portland masons engaged by George Washington, who instructed them to use rubblestone taken from fields and shores. During the Civil War, when raids on shipping required sighting the light from greater distances, the tower was raised 8 feet. Today it stands 80 feet above land and 101 feet above water at the southern entrance to Portland Harbor. It is one of the four Colonial lighthouses that have never been rebuilt.

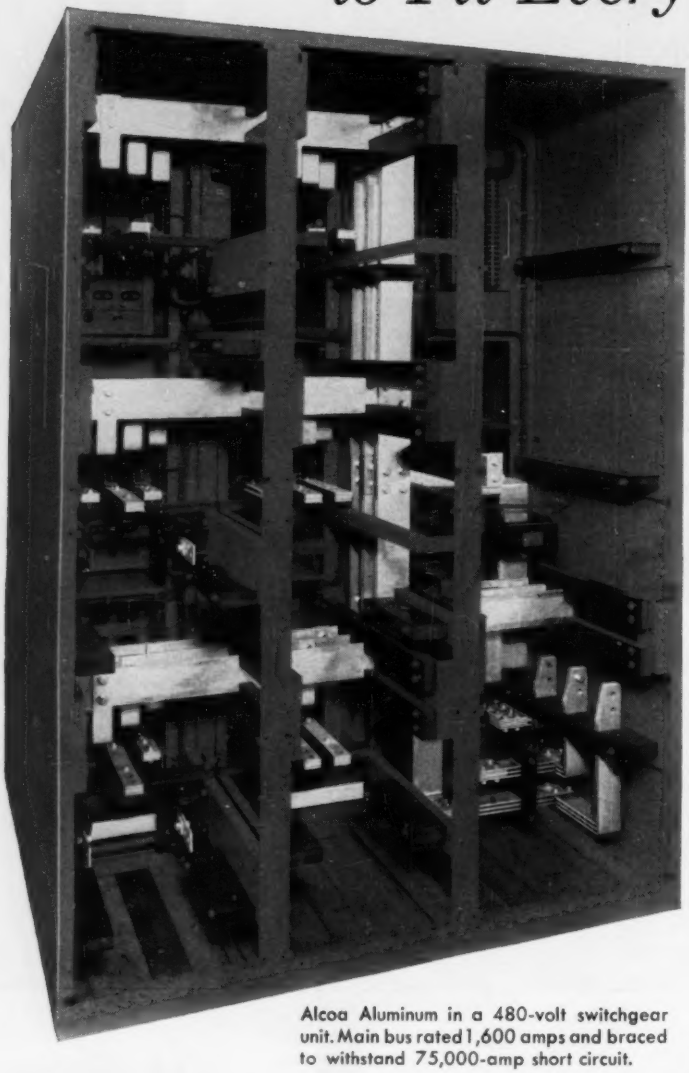
A Landmark of Quality in the field of electrochemicals is the name Niagara Alkali Company. First to produce several of these important chemicals in America, Niagara is a pioneer in their development and application. You can rely on Nialk® Liquid Chlorine, Nialk Caustic Potash, Nialk Carbonate of Potash, Nialk Paradichlorobenzene, Nialk Caustic Soda, Nialk TRICHLORethylene, Niagathal® (Tetrachloro Phthalic Anhydride).

NIAGARA ALKALI COMPANY

60 East 42nd Street

New York 17, N. Y.

There's an Alcoa® Aluminum Bus Conductor Engineered to Fit Every Bus Application



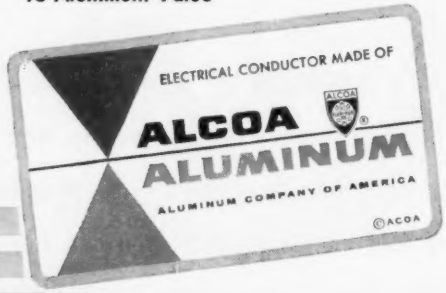
Alcoa Aluminum in a 480-volt switchgear unit. Main bus rated 1,600 amps and braced to withstand 75,000-amp short circuit.

Here is a recent switchgear application of Alcoa Aluminum Bus Conductors. Earlier Alcoa Aluminum Bus Conductor installations of this type are still in operation after thirty years of heavy-duty service in electrochemical plants, steel mills and public utilities.

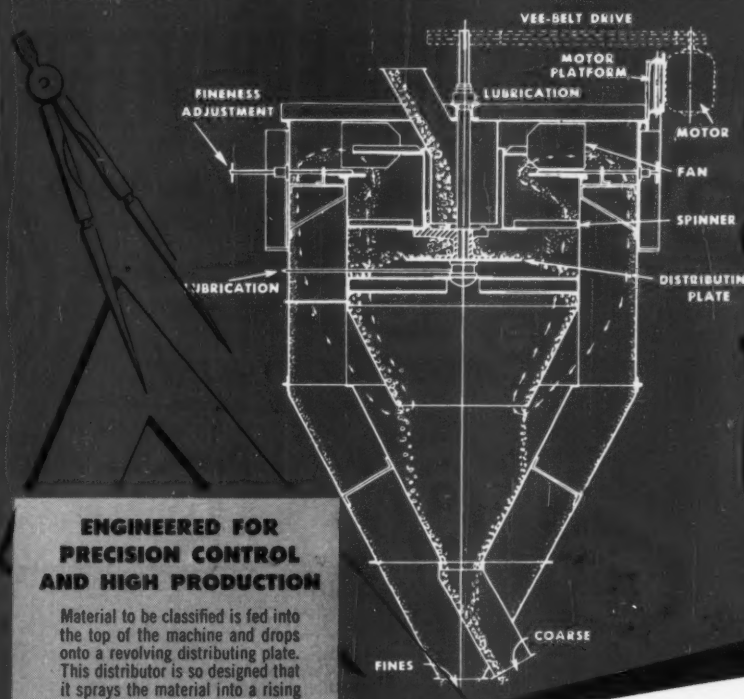
Alcoa offers shapes, alloys and tempers designed to meet even the most specialized mechanical and electrical requirements, giving you significant savings in material and installation costs. Whatever your installation or bus design problem is, there's an Alcoa Aluminum Bus Conductor so right for the job it's almost custom fabricated.

Let us help you with your design to get the most out of the many types of Alcoa Aluminum Bus Conductors available. If you'd like to see what you can expect of this modern electrical metal, ask your local Alcoa sales office for a copy of *Service Records of Alcoa Aluminum Bus Conductor Installations*. Or write Aluminum Company of America, 2309-H Alcoa Building, Mellon Square, Pittsburgh 19, Pennsylvania.

Your Guide To Aluminum Value



ALWAYS USE ALCOA ALUMINUM ACCESSORIES WITH ALUMINUM CONDUCTORS



More Accurate Sizing Of Ground And Pulverized Materials!

ENGINEERED FOR PRECISION CONTROL AND HIGH PRODUCTION

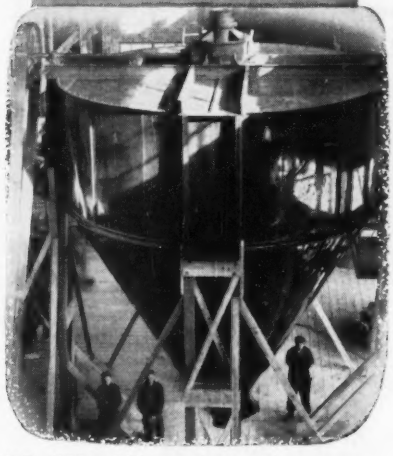
Material to be classified is fed into the top of the machine and drops onto a revolving distributing plate. This distributor is so designed that it sprays the material into a rising air current which entirely surrounds the plate. The finer particles are lifted by the air stream and the coarse particles drop down to the reject spout. Passing up through the separating chamber, the dust-laden air is given a whirling motion between Spinner blades and any remaining oversize particles are precipitated. The separator is adjustable to control the fineness of the finished product with unusual accuracy.

WILLIAMS MECHANICAL AIR SEPARATORS

For Finenesses From 30 to 325 Mesh

- Most efficient mechanical air separator ever developed for classifying ground and pulverized materials, or for removing fines from dry ground materials before classifying.
- Product quality is vastly improved and output considerably increased when operated in closed circuit with virtually any type of mill.
- Will handle with equal efficiency a complete range of products—mineral, chemical and vegetable—from the hardest, most dense limestone and ore to the softest, fluffiest starches and flours.
- Permits coarser settings in grinding equipment thus lengthening equipment life by reducing wear on all moving parts. Power consumption is much lower.
- Extra heavy construction. Equipped with anti-friction bearings encased in dust-proof and moisture-proof housings. All casings are of heavy steel plate construction. Operation is dustless and repair cost is practically nil, since there are no fine sieves to wear out and the heavy construction insures long life.

9 Standard sizes, 2½ to 18-foot diameters — Capacities from 500 lbs. to 75 tons hourly



18-Foot Williams RC Separator being tested at plant before shipment.

Write For Details And Describe Your Operation

WILLIAMS PATENT CRUSHER & PULVERIZER CO.

2706 NORTH NINTH • ST. LOUIS 6, MO.

WILLIAMS

CRUSHERS GRINDERS SHREDDERS

OLDEST AND LARGEST MANUFACTURER OF HAMMER MILLS IN THE WORLD

In fully-staffed, modern laboratory, miniature equipment is used to test small batches sent to Link-Belt.

Full-scale facilities are used for large runs. Over 1000 of these tests have been made, on more than 100 products.

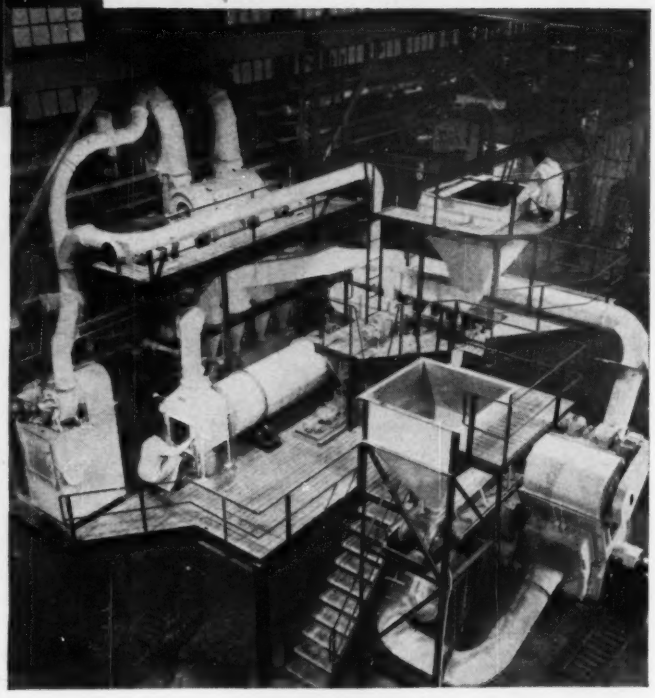
YOU'RE INVITED

to send us a sample

of your material

. . . a pound

or a ton . . .



We'll work out drying, cooling or roasting procedures for you

WHAT'S the best drying, cooling or roasting method for processing your materials? Hundreds of plants throughout the world have found an exact, detailed answer through Link-Belt test runs. Here's how it works:

- You send a representative sample of your product — a pound or a ton — with a complete description . . . covering initial moisture, critical temperatures and your merchandising objectives.
- On equipment like that shown above, our specialists conduct test-runs — find how to blend, compound or convert it to desired chemical composition. Our analytical laboratory will determine needed catalyst or agents to be added, if tests so indicate.
- With probable efficiencies decided, we'll lay out flow charts of methods you can follow in your own plant.

If shipping your product is impractical, we'll gladly set up a pilot unit on loan at your plant. Write or send samples to LINK-BELT COMPANY, 300 West Pershing Road, Chicago, Ill.

LINK-BELT

DRYERS · COOLERS · ROASTERS

ROTO-LOUVRE

MULTI-LOUVRE

OSCILLOUVRE

MONOTUBE

LINK-BELT COMPANY: Executive Offices, 307 N. Michigan Ave., Chicago 1. To Serve Industry There Are Link-Belt Plants and Sales Offices in All Principal Cities. Export Office, New York 7; Canada, Scarboro (Toronto 13); Australia, Marrickville, N.S.W.; South Africa, Springs. Representatives Throughout the World. 13792

Just off the press... this 20-page illustrated booklet is jam packed with valuable information to help you save drafting time... protect drawings... get better prints

Mailed to you... *FREE!*

You'll find all the answers here—

- ☐ How to get low-cost protection for your valuable drawings
- ☐ How to revise drawings without redrafting
- ☐ How to get sparkling prints from "unprintable" originals
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Kodagraph Reproduction Materials
for new techniques . . . new savings . . .
new standards of quality—
in drawing and
document reproduction

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All of this . . . and much more. Send for this valuable booklet today. No obligation whatsoever!

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"THE BIG NEW PLUS" in engineering drawing reproduction

MAIL COUPON FOR FREE BOOKLET

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EASTMAN KODAK COMPANY
Graphic Reproduction Division, Rochester 4, N.Y.
Gentlemen: Please send me a free copy of your new booklet on Kodagraph Reproduction Materials.

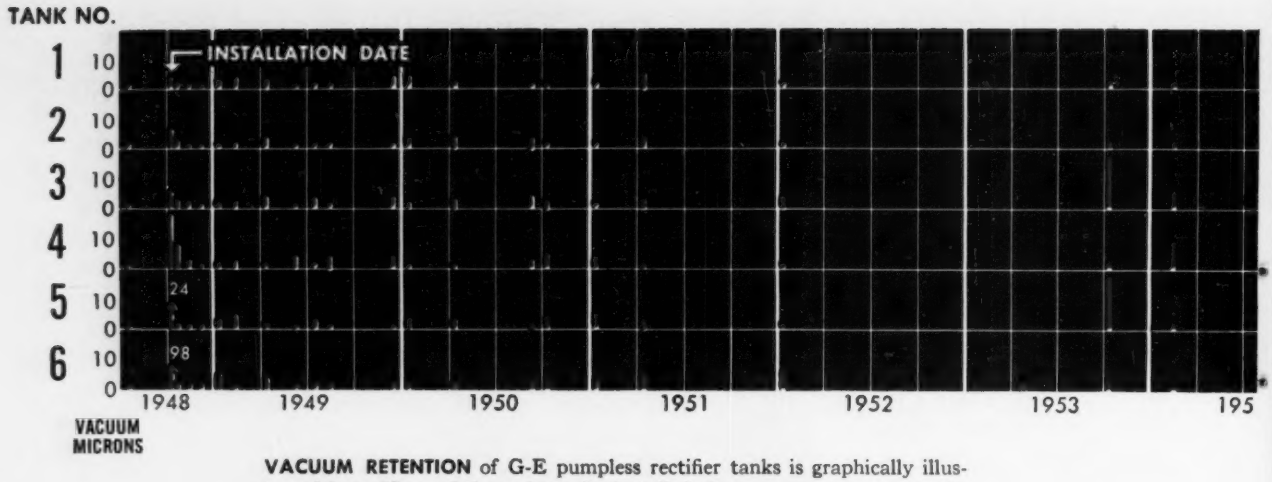
Name _____ Position _____

Company _____

Street _____

City _____ Zone _____ State _____

Kodak



VACUUM RETENTION of G-E pumpless rectifier tanks is graphically illustrated here. None of these six tanks, installed almost seven years ago at the Buffalo plant of the Wickwire Spencer Steel Division of the Colorado Fuel and Iron Corporation, has ever required maintenance. This endurance test is conclusive proof that the G-E pumpless tank is an outstanding performer.

Not one cent has ever been spent for repairs on a G-E pumpless rectifier tank

Since 1948—when the first General Electric pumpless rectifier unit was installed—not a single customer anywhere in the country has paid out a penny for vacuum tank repair. And this is only a start. G-E engineers estimate a much longer life for this equipment. Here's why:

"PERMANENTLY-SEALED" TANKS, manufactured under almost antiseptic conditions, eliminate the need for a pumping system. This, in turn, eliminates such problems as mercury migration between tanks and the possibility of shutdown due to vacuum-system failure.

SUPERIOR MANUFACTURING AND TESTING methods have made this exclusive sealed-tank design possible. Tanks are assembled in a special air-conditioned room, then baked, pumped-down and sealed to assure the best possible vacuum. To check the possibility of even the most minute leak, tanks are pumped in a helium atmosphere and the exhaust is examined by a mass spectrometer leak detector capable of detecting one part of helium in 100,000 parts of normal air.

FACTORY RECONDITIONING of tanks, should it be necessary, is a relatively inexpensive process and relieves you of tank maintenance problems. The tank is reconditioned under the same controlled factory conditions described above and returned ready for more years of service. You can operate with a spare tank during reconditioning.

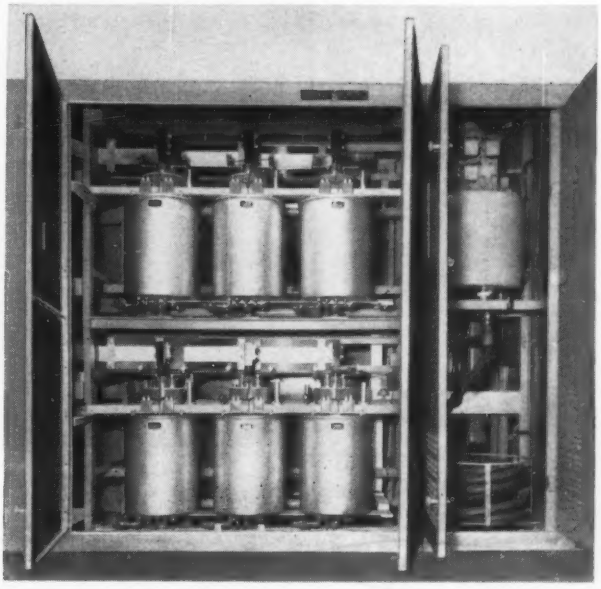
ADD TO THIS the highly efficient operation of mercury-arc conversion and you'll find that G-E pumpless rectifiers are the most economical way to get d-c power in the 750-kw range and above. For the whole story, contact your nearest G-E Apparatus Sales Representative or write for bulletin GEA-5689. General Electric Company, Schenectady 5, New York. 524-2

Progress Is Our Most Important Product

GENERAL ELECTRIC

ASSEMBLY ROOM for pumpless-rectifier tanks is clean, air-conditioned to help prevent contamination. After assembly, testing with mass spectrometer leak detector assures that tanks are free from even the most minute leaks.

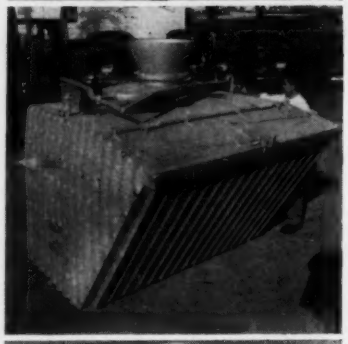
LONG LIFE AND LOW MAINTENANCE are the payoff when these tanks are put into service. The six-tank rectifier compartment shown here is furnished with transformer and associated a-c and d-c switchgear—a completely metal-enclosed d-c substation which requires a minimum of floor space.



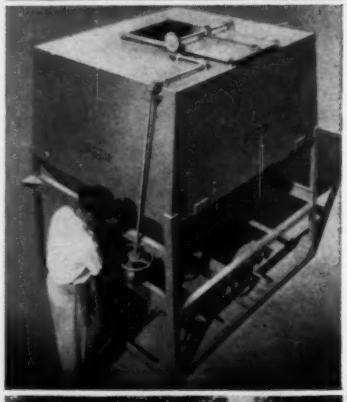
GENERAL ELECTRIC

Briefly, this ad illustrates why DEMPSTER-DUMPSTER SYSTEM

Container at right has cast iron bottom and inside walls are lined with fire brick. It handles hot skim off aluminum.



This Tilt Type Container was the result of a cost-cutting idea whereby a high temperature dusty product would be handled by a plant's Dempster-Dumpster. Container has cooling fins, counter-balanced hinged lid with 3-way locking device, 16" sliding gate valve and two sight-glass inspection openings.



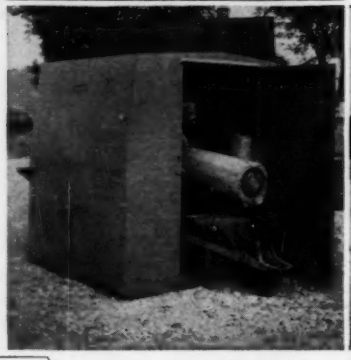
Here is a Hopper Type Container with a top door for filling and two bottom discharge doors operated by rack and pinion. Another case where the Dempster-Dumpster System was applied to an additional problem to further reduce costs.

IN A NORMAL INSTALLATION the Dempster-Dumpster System is purchased by a plant because of its proved record for handling bulk materials at tremendous savings. This normal installation usually includes one truck mounted Dempster-Dumpster and any number of standard containers designed to meet the various requirements within the plant. In some cases, containers number 40 to 50. These containers can range in capacity up to 21 cu. yds., with all containers served by the one Dempster-Dumpster.

In the great majority of cases this basic installation is just a starter. Management men, constantly looking for lower operating costs, find numerous and amazing extra savings in the Dempster-Dumpster System. Once in service, transporting developments of every description come to light that supplement the original functions of the equipment. Your own men find easier, quicker and additional cost saving ideas for its use. Many even overshadow the original savings and the equipment becomes more and more indispensable.

Look over just a few of the "Special" containers illustrated in this ad. They are all the result of rough ideas that originated with the men in plants after a basic installation, then developed by our engineers. All ideas were stimulated by the powerful Dempster-Dumpster and its flexibility in picking up, hauling, setting down or dumping anything that needs transporting, at lower cost.

One man, the driver, and a few simple hydraulic controls in the cab of a Dempster-Dumpster, will become indispensable in your plant. It is just that in hundreds of plants of every description throughout the nation. Let one of our representatives give you details of installations. Manufactured exclusively by Dempster Brothers, Inc.



Container at right is just one of several different types we have designed to handle equipment, materials, packages, parcels, etc.

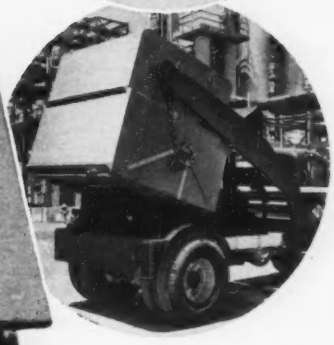
Above container is built with cast iron liner. The holes in outer wall are for cooling.

Here is one of several special drop bottom type containers equipped with couplers and ball bearing trucks for operation in train on rails.

THE DEMPSTER DUMPSTER SYSTEM

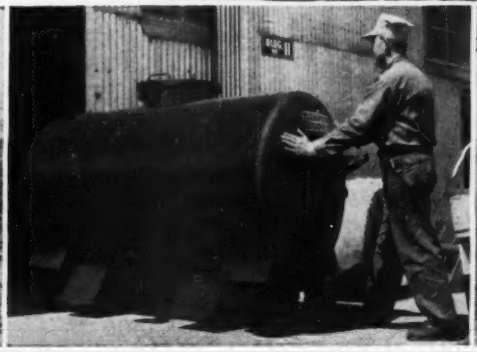
DEMPSTER BROTHERS

so many plants find the indispensable...

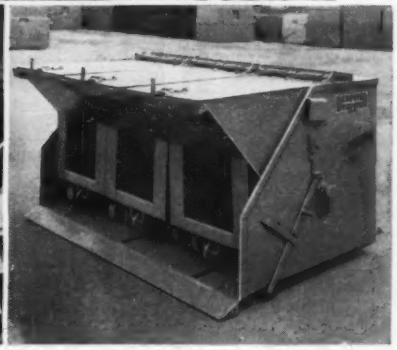


Two photos above show how all containers, regardless of design, are picked up and hauled. At destination materials are dumped from drop bottom containers as shown at left . . . from Tilt and Skip Type Containers by tilting. Any load, of course, may be set down intact.

This is a special adaptation whereby waste zinc slurry is pumped into two containers, which serve as settling tanks, enabling majority of the water to be decanted before sludge is transported and dumped at waste basin.

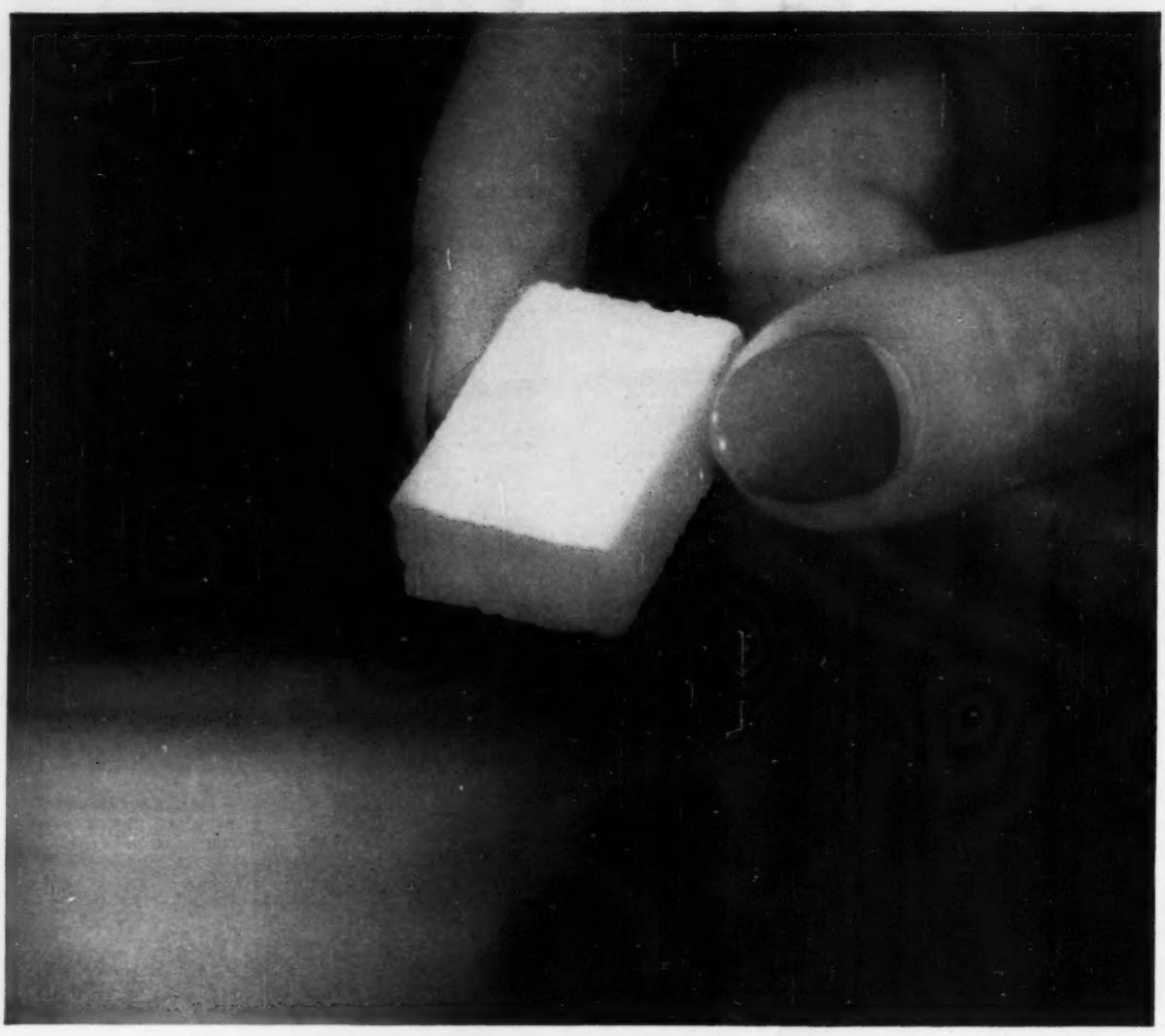


Tank Type Containers are available with or without casters in steel, aluminum, stainless steel, etc. Capacity ranges up to 1,200 gal. They may be lined with rubber, lead, highly resistance coatings, etc.



This is a master container with three 2 cu. yd. insert containers. Each insert container is provided with casters, counter-balanced spring-hinged lid for loading and dumping.

285 DEMPSTER BLDG., KNOXVILLE 17, TENNESEE



"VIRGINIA" SODIUM HYDRO IMPROVES RAW SUGAR PRODUCTION

Maybe there's money in this story for *you* too!

The sugar industry has discovered that "Virginia" Sodium Hydrosulphite ($Na_2S_2O_4$), when added at the right point in process, improves crystallization, increases purity and steps up the yield. This has meant an added and substantial profit for sugar men.

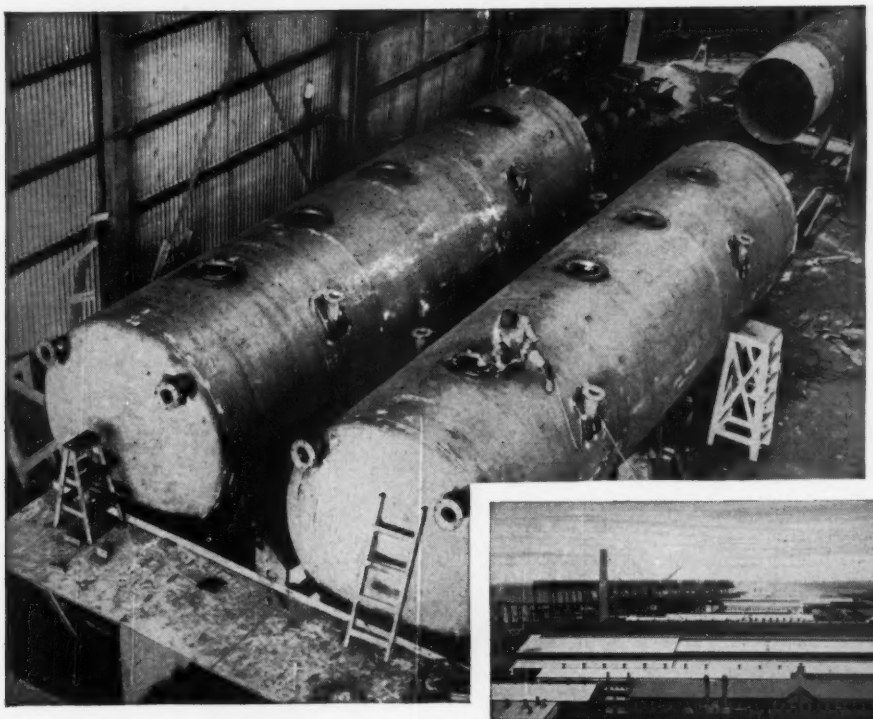
Here is a case typical of many where "Virginia" reducing and bleaching agents, SO_2, sodium and zinc hydrosulphites have saved important money.

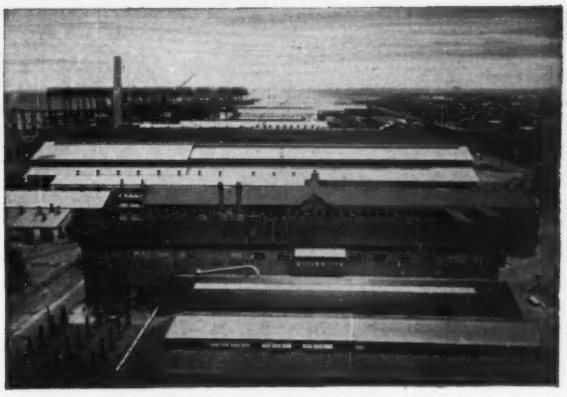
Over the past 20 years, Virginia technical men have made significant contributions in adapting Virginia Chemicals to more than 40 diverse industries. This technical know-how can be invaluable to anyone who is looking into a new development or a process improvement. This, plus a dependable and economical chemical supply source, is good reason for calling in "Virginia" during the early planning stages.

Industrial Department
VIRGINIA SMELTING COMPANY
Box 21, West Norfolk, Virginia

VIRGINIA Chemicals

Field Offices: NEW YORK • BOSTON • DETROIT
CHICAGO • ATLANTA • ASHEVILLE
Available in Canada and many other countries





A Mile of Shops — Each shop is devoted to a special type of heavy production. Included are complete Machine Shops, casting, forging and other facilities which offer all of the advantages of the execution of the complete job.

A half mile of pressure vessels

These are two of seventy — over ½ mile — of 38½-foot vacuum tank casings built to meet the quality requirements of a well-known chemical maker.

The buyer also benefits from many savings made possible by Newport News extensive heavy fabrication equipment and the sixty years experience in using it.

Do you plan installations of heavy production equipment? You can command the services of Newport News for weldments of corrosion-resistant, alloy and clad metals in almost any size or shape, plus the required engineering background and complete welding and stress-relieving skills.

It will pay you to get the facts, shown in *Facilities and Products.* As you glance at its photos and brief captions, you'll see why Newport News can turn out — at low cost — specialized heavy equipment for chemical plants.

Send for *Facilities and Products* — free — today.

Newport News
Shipbuilding and Dry Dock Company
Newport News, Virginia

INSIDE STORY
on cooling tower pH

Deep in the interior of a giant cooling tower visibility is obscured by shadows, and haze that's actually cooling water, falling like rain down into the tower basin, where it's collected and recirculated to the condensers.

Keeping this water at optimum pH, when it collects in the basin, was once a difficult problem. But the application of practical engineering principles, resulting in the baffle-lined distributing trough and regulated reagent feed shown here, plus L&N's pH Controllability Analysis, offers a new and successful solution to this problem.

For it's here, *inside the tower*, that vital pH control can be most effective for slime control, scale prevention, wood protection, and conservation of make-up water.

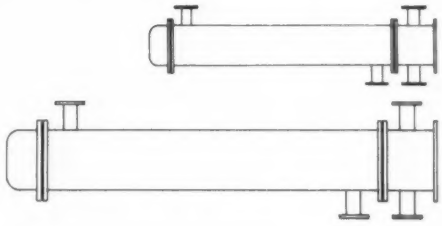
We'll be glad to send you details on the "inside story" of tower pH. Write Leeds & Northrup Co., 4907 Stenton Ave., Phila. 44, Pa., for Process Data Sheet 700(1).

LEEDS [LN] **NORTHRUP**
instruments — *automatic controls • furnaces*

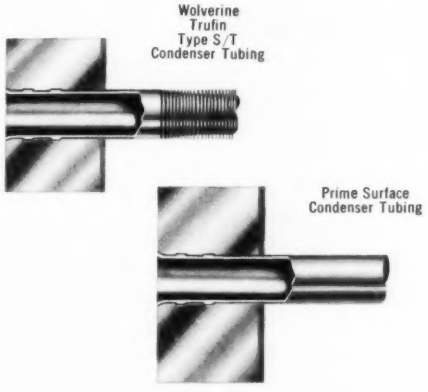
Trufin Opportunities
Number 8 of a series.

4 REASONS WHY WOLVERINE TRUFIN* SHOULD BE USED FOR DEPROPANIZER HEAT EXCHANGERS

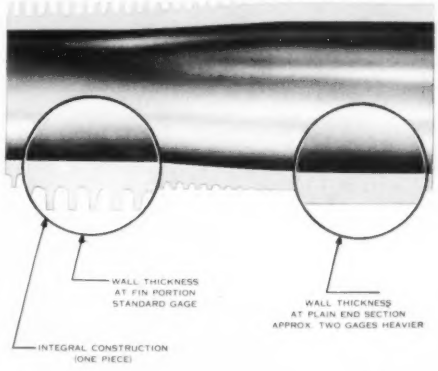
1. *Extra Efficiency* — Wolverine Trufin Type S/T condenser tube has integral fins — provides more than 2½ times the outside surface of prime surface tubing. You get *more heat transfer per foot of tube with Trufin!*



2. *Lower Unit Cost* — Users report substantial savings by designing and retubing depropanizer heat exchangers with Trufin. The additional outside surface area permits the use of less tubing for a given heat duty. You get *smaller shells, baffles, reduced fabricating costs, fewer tubes to clean!*



3. *Simplified Installation* — Trufin rolls into headers as easily as plain tube — using the same methods of fabrication. Standard rolling tools are used. You get *no deviation from existing fabrication procedures.*



4. *Designed for the Job* — Trufin Type S/T is designed specifically for shell and tube heat exchangers. The cutaway photograph graphically portrays its uniqué one-piece construction. You get *condenser tubing designed with the stand-up stamina for tough going . . . designed to do a better job, consistently.*

Investigate today — *and save!* Write for Wolverine's Opportunity book. WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

*REG. U.S. PAT. OFF.

EST. 1916

WOLVERINE TUBE
DIVISION OF CALUMET & HECLA, INC.
Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

Let's Talk S-C-O-P-E

OF CONDENSER TUBE PRODUCTS

one refinery superintendent asked us . . .

Yes, I can see the cost-saving possibilities of Wolverine Trufin*. But tell me this—

Q. Just how broad is the scope of your activities in the petroleum and petro-chemical fields?

A. We produce heat exchanger tubes in a wide range of metals—copper, copper-base alloys, aluminum and electric-welded steel. The latter two metals are produced in a wide variety of alloys, too. We have a complete range of sizes and can furnish both prime surface and finned heat exchanger tubes. Incidentally, Trufin Type S/T is a natural for shell and tube heat exchangers.

Q. Our bugaboo is salt water corrosion—any suggestions?

A. Our Field Engineering Service is set up to handle questions like this. They'll help you pick the right heat exchanger tube which will best stand up under any corrosion problem you have.

Q. Will this field service help us in other ways?

A. Definitely! The group is composed of tube technicians—each a counsellor in corrosion, fabrication, you name it! They solve tough problems like yours every day.

Q. Run down the list of your condenser tube products again.

A. In addition to Trufin Type S/T and prime surface tubing, there's Trufin in bi-metal—an exterior tube of lightweight, high-finned aluminum and a liner of a metal to suit your particular corrosive condition. This tube works out well where high thermal efficiency is a problem. We call it Trufin Type L/C. Then we produce plain duplex heat exchanger tubes and duplex Type S/T Trufin heat exchanger tubes. A popular combination of metals, for example, is a welded steel outer (plain or finned) tube with an inhibited Admiralty liner. You might be interested in knowing that we provide a direct mill source of supply for all your U-Bend, fin or plain heat exchanger tubes. All your requirements can be handled directly with Wolverine. And we ship them to you in a box-type disposable pallet so that you can feed them right into the heat exchanger.

*REG. U.S. PAT. OFF.

Wolverine Trufin is available in Canada through the Unifin Tube Company, London, Ontario.

But the best proof of what Wolverine Tube can do will be demonstrated in a job quotation. We'd like the opportunity to help you. Write for a copy of Wolverine's condenser heat exchanger book. WOLVERINE TUBE, 1443 Central Avenue, Detroit 9, Michigan.

EST 1916

WOLVERINE TUBE

DIVISION OF CALUMET & HECLA, INC.

Manufacturers of Quality-Controlled Tubing and Extruded Aluminum Shapes

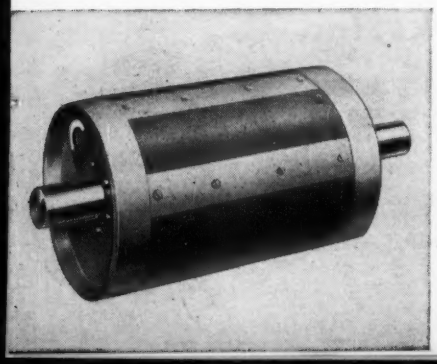
PLANTS IN DETROIT, MICHIGAN, AND DECATUR, ALABAMA. SALES OFFICES IN PRINCIPAL CITIES

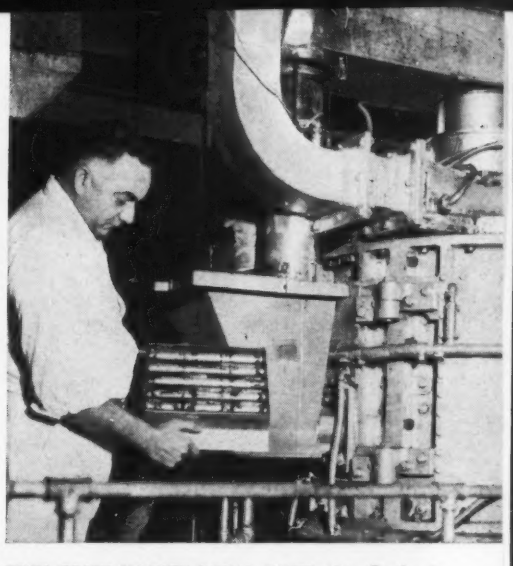
EXPORT DEPT., 13 E. 40TH ST., NEW YORK 16, N. Y.

OLD IRON PANTS AND THE MAGNET! A lady from yesterday with a metal-ribbed girdle wouldn't be safe next to an Eriez Permanent Magnet. She might easily be "hung up" by the powerful Alnico V action. This idea of herculean power is practically applied in industrial processing lines. Magnets convey and control metals, and remove dangerous tramp iron preventing fires, machinery damage and product contamination. *All Eriez Magnets are non-electric, self-contained. They operate without any wires or attachments. Best of all their magnetic power lasts a lifetime. The first cost is the last.*

MAGNETIC IDEAS FROM ERIEZ

ERIEZ PULLEY WATCHES YOUR BELTLINE. The idea of this Eriez Magnetic Pulley is to reduce tramp iron . . . tramp iron which is hidden in wet or dry material passing on conveyor belts of rubber, leather, canvas, stainless steel, etc. Pulley sizes range from 4" to 30" diameter, in belt widths from 4" thru 72". The rugged construction and powerful magnetic strength of Eriez Pulleys give you trouble-free operation and efficient protection against tramp iron damage to costly crushers, grinders, pulverizers, stokers, etc. Want more information on this product? . . . request Bulletin 501.



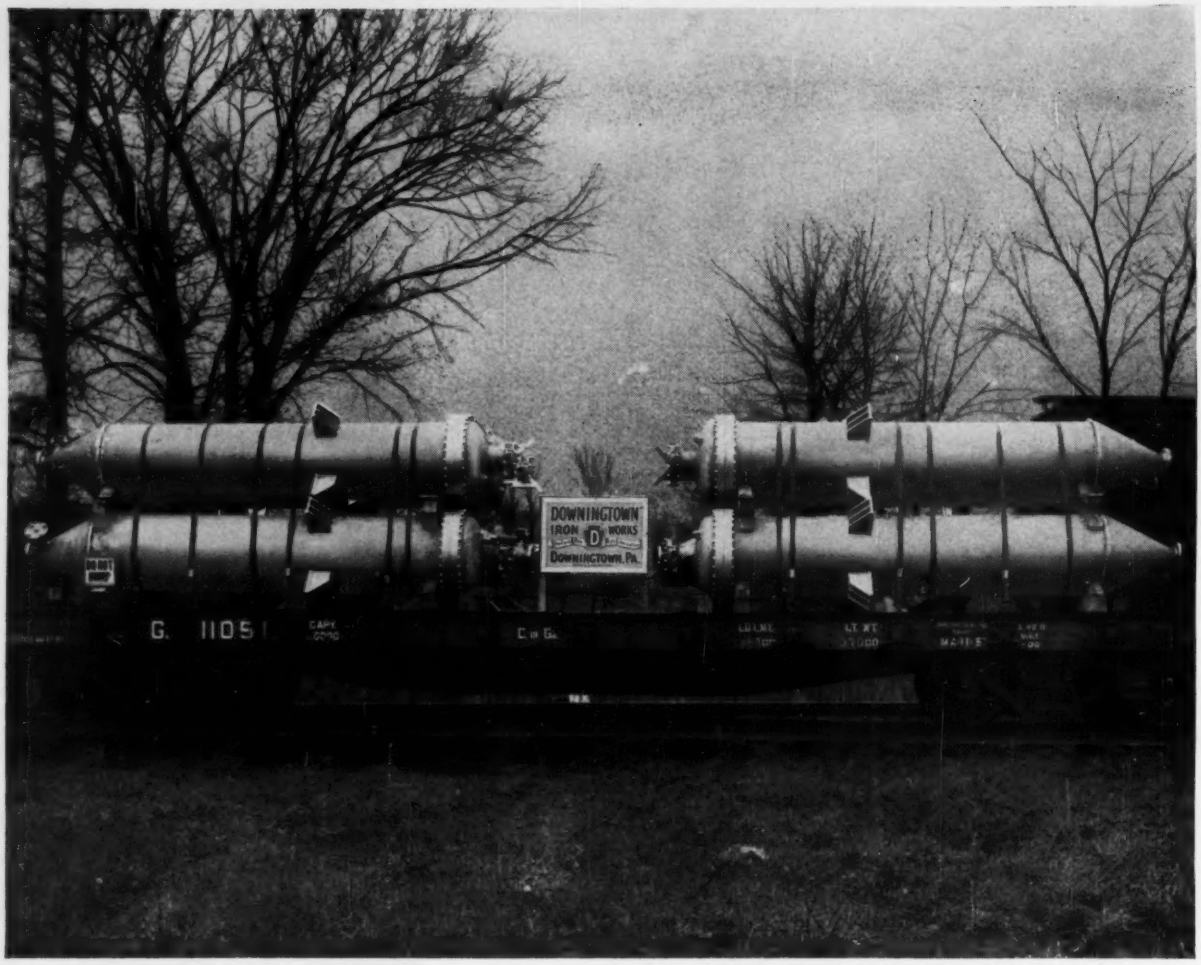


ERIEZ GRATE MAGNET DOING SWEET JOB. *Purity* is the watchword at Boweys, Inc., Chicago concern making quality chocolate powder and syrups. Fine iron contamination and an occasional nut or bolt (tramp iron) could cause product contamination and damage the mills that grind to extremely close tolerances. To protect both product and machinery, an Eriez Permanent Grate magnet was installed in the feed hopper of a Raymond mill. It has proved very efficient; the foreman insists he would not run his mills without it. Eriez Grate magnets are so successful at removing fine bits of metal from free-flowing processing lines, that a recent quality-control test by an independent laboratory showed a single Eriez magnet removed 93% of 100-200 mesh iron.

ERIEZ DRUM MAKES BORING JOB PAY OFF. W. F. Jobbins Co., Aurora, Ill., recently solved a problem that was both expensive and troublesome. Valuable aluminum chips were being lost in iron tailings. Previously, the tailings were collected during the week and re-run on a double deck separator on the weekend, in order to salvage the aluminum from the waste tailings. Now, with an Eriez Permanent Magnetic Drum, the tailings are so free of aluminum there's no need to re-run them. This process saves 4 to 8 man hours daily. The magnet functions so efficiently, the company reports, that loss of aluminum to iron tailings is less than lab figures show it should be! Want to know what an Eriez Drum can do for you? Request 6-page Bulletin B-601.

ERIEZ

Eriez' free booklet "Magnetic Ideas" can help you. Send for it without obligation. Address: Eriez Manufacturing Company, 74V Magnet Drive, Erie, Pa. Or, on your specific request Eriez' factory-trained field men backed by Eriez' laboratory and engineering know-how will be happy to study your particular problem, make a plant survey and offer helpful "Magnetic Ideas".



Another carload shipment of 8 process tanks, each 32" O.D. by 13'0" long, fabricated at Downingtown of stainless steel, type 304.

REPEAT ORDERS PROVE

Downingtown Built means Quality Built

These eight stainless steel process tanks form just one of many carload shipments ordered by one customer during the past several years.

Complete satisfaction with workmanship, price and delivery—that's why so many leading chemical, refinery and other process plants turn to Downingtown again and again with repeat orders for their complex plate fabrication work.

They know they can call on our experienced staff of engineers to help work out complex design and construction details. They know they can rely on Downingtown skill and experience for quality workmanship. They know Downingtown is thoroughly experienced in working and welding many alloys and clad materials, as well as the carbon steels and stainless steels.

Put your plate fabrication problems into experienced hands—at Downingtown Iron Works. Code work a specialty, and authorized insurance company inspection regularly available.

For further information, send for bulletin PF.

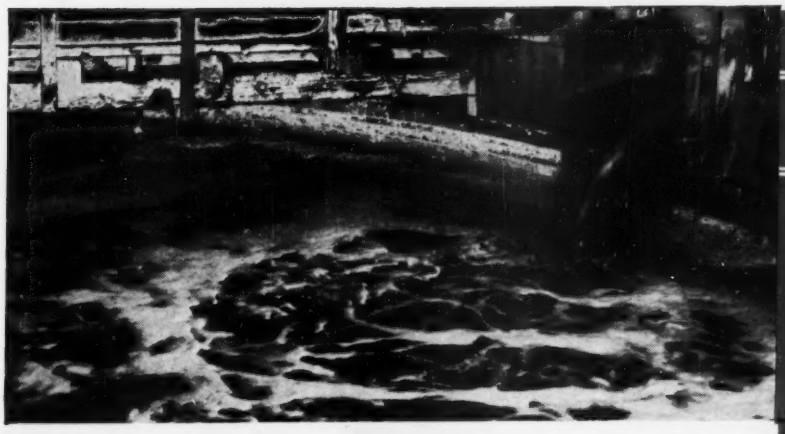
Downingtown Iron Works, Inc.

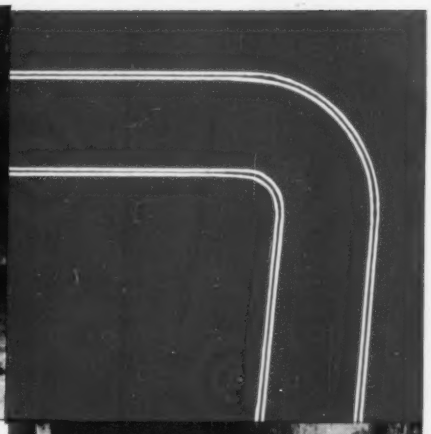
140 Wallace Ave., Downingtown, Pennsylvania
New York Office: 52 Vanderbilt Avenue, New York 17, N. Y.

HEAT EXCHANGERS • TOWERS • PRESSURE VESSELS • STORAGE TANKS • STEEL AND ALLOY PLATE FABRICATION

DIVISION OF: Pressed Steel Tank Company
Manufacturer of Hackney Products • Milwaukee 14, Wisconsin

CONTAINERS AND PRESSURE VESSELS FOR GASES, LIQUIDS AND SOLIDS





WILFLEY ACID PUMPS

Proven Efficiency

.....handling Acids, Corrosives, Hot Liquids and other solutions

The record of Wilfley Acid Pumps is written in hundreds of modern chemical plants throughout the world where Wilfleys are a vital factor in reducing costs and increasing production.

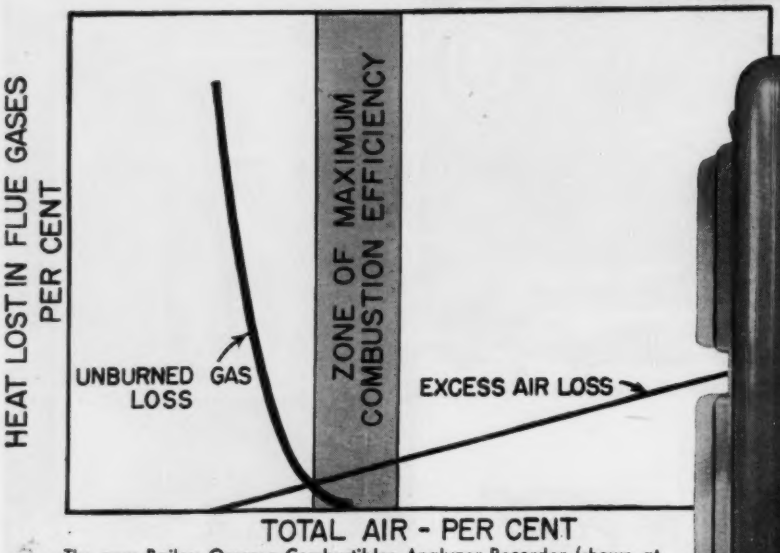
Absolute dependability under the pressure of round-the-clock schedules has established Wilfley Acid Pumps as the leader in this field. Available with pumping parts of machinable alloys as well as plastic to meet all requirements. Individual engineering on every application.

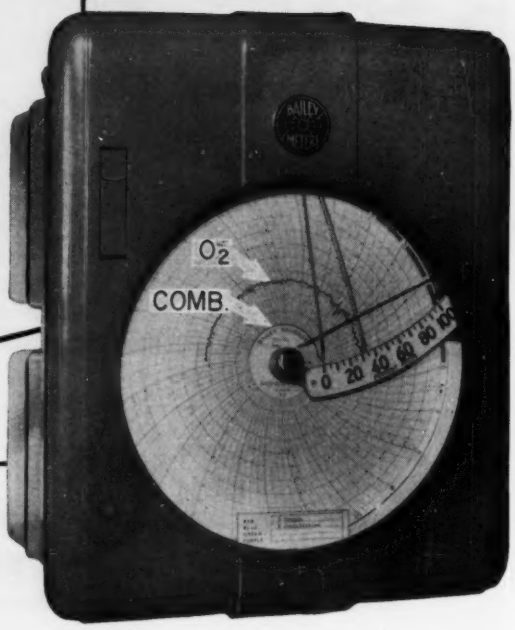
A Wilfley Acid Pump handling a Zinc Electrolyte.

Write or wire for complete details.

Wilfley Acid Pump
"COMPANIONS IN ECONOMICAL OPERATION"
Wilfley Sand Pump

A. R. WILFLEY and SONS, INC., DENVER, COLORADO, U. S. A.
New York Office: 1775 Broadway, New York City


HEAT LOST IN FLUE GASES PER CENT
UNBURNED GAS LOSS
ZONE OF MAXIMUM COMBUSTION EFFICIENCY
EXCESS AIR LOSS
TOTAL AIR - PER CENT



The new Bailey Oxygen-Combustibles Analyzer-Recorder (shown at right) provides a continuous two-in-one check of combustion efficiency by recording both oxygen and combustibles in flue gas. As shown by above chart, both measurements are needed to determine combustion efficiency.

BAILEY announces · · · New 2 in 1 way to measure Combustion Efficiency

The new Bailey Oxygen-Combustibles Analyzer-Recorder gives you a continuing double check on combustion economy. It's fast response measures and records:

1. Excess air—regardless of the fuel or combinations of fuels being burned.

2. The mixing efficiency of your fuel-burning equipment—by indicating the amount of combustibles in your flue gas, resulting from incomplete mixing of fuel and air.

Combustion efficiency depends upon fuel-air ratio. Too much fuel can be even more costly than too much air. And because of the interdependence of these two factors, no control that measures only one of them can give you complete protection.

Now, for the first time, you can check *both* with a *single* fast acting instrument, using the new Bailey Oxygen-Combustibles Analyzer-Recorder for industrial furnaces, kilns, heaters and boilers.

Fuel economy improves as excess air is reduced —until unburned fuel begins to show up in the flue gas. When this happens, combustion efficiency drops off sharply if there are further decreases in the air-fuel ratio. That's why combustion gases must be analyzed for *both* oxygen and combustibles to get a true indication of efficiency—and that is why Bailey coordinates both measurements on the same chart, to show when excess air may be reduced safely without danger of greater losses from unburned gases.

The Bailey Oxygen-Combustibles Analyzer is an approved combustion safeguard.

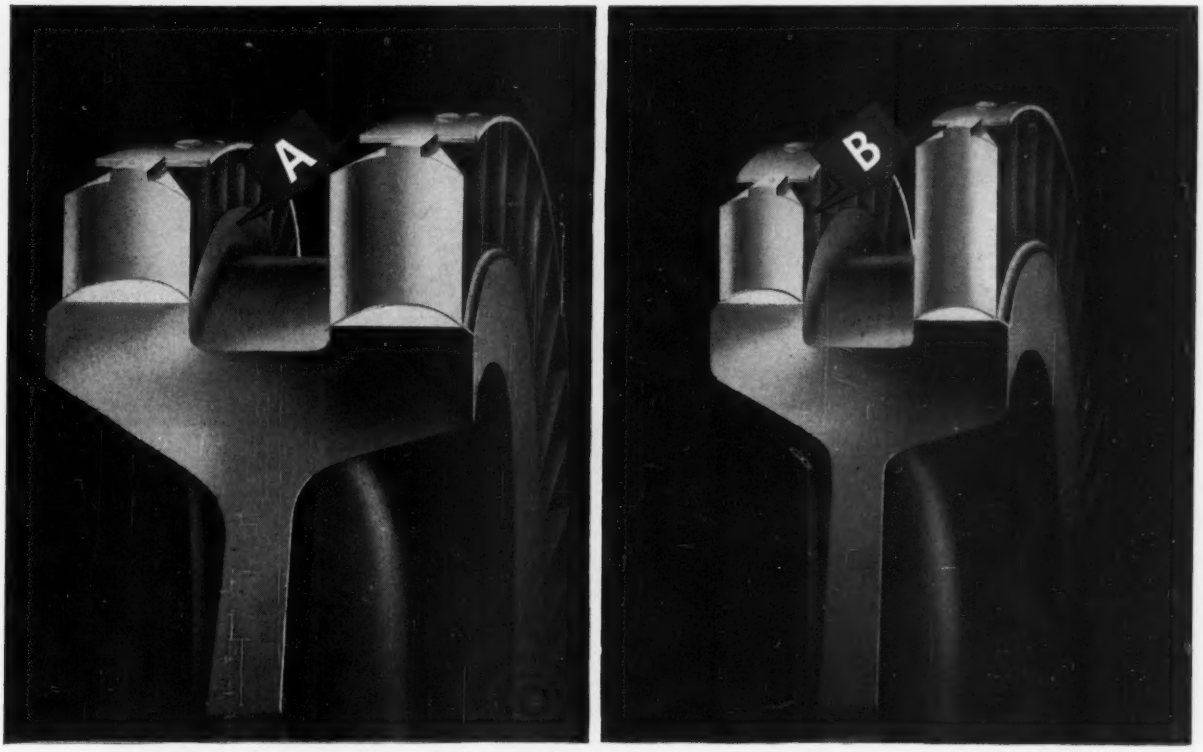
Ask your local Bailey engineer for suggestions on application. Equipment details in Product Specifications E65-1 and E12-5. P31-1

BAILEY METER COMPANY

1054 IVANHOE ROAD • CLEVELAND 10, OHIO

INSTRUMENTS AND CONTROLS

For Power And Process



(Left, A) wide bucket "L" type wheel. (Right, B) regular type wheel for Coppus Steam Turbines

Now...for low steam consumption – **COPPUS TURBINES** *can be furnished with wide bucket "L" type wheel*

Good news for steam turbine users where low steam consumption is important!

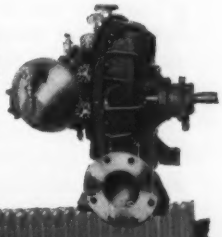
The Coppus Type "L" Wheel is the answer to this problem. Larger turbine buckets are employed to make the most economical use of steam.

In every respect the Coppus Turbine offers the top-quality features and advantages that have made the Coppus line outstanding for efficiency and economy. For example:

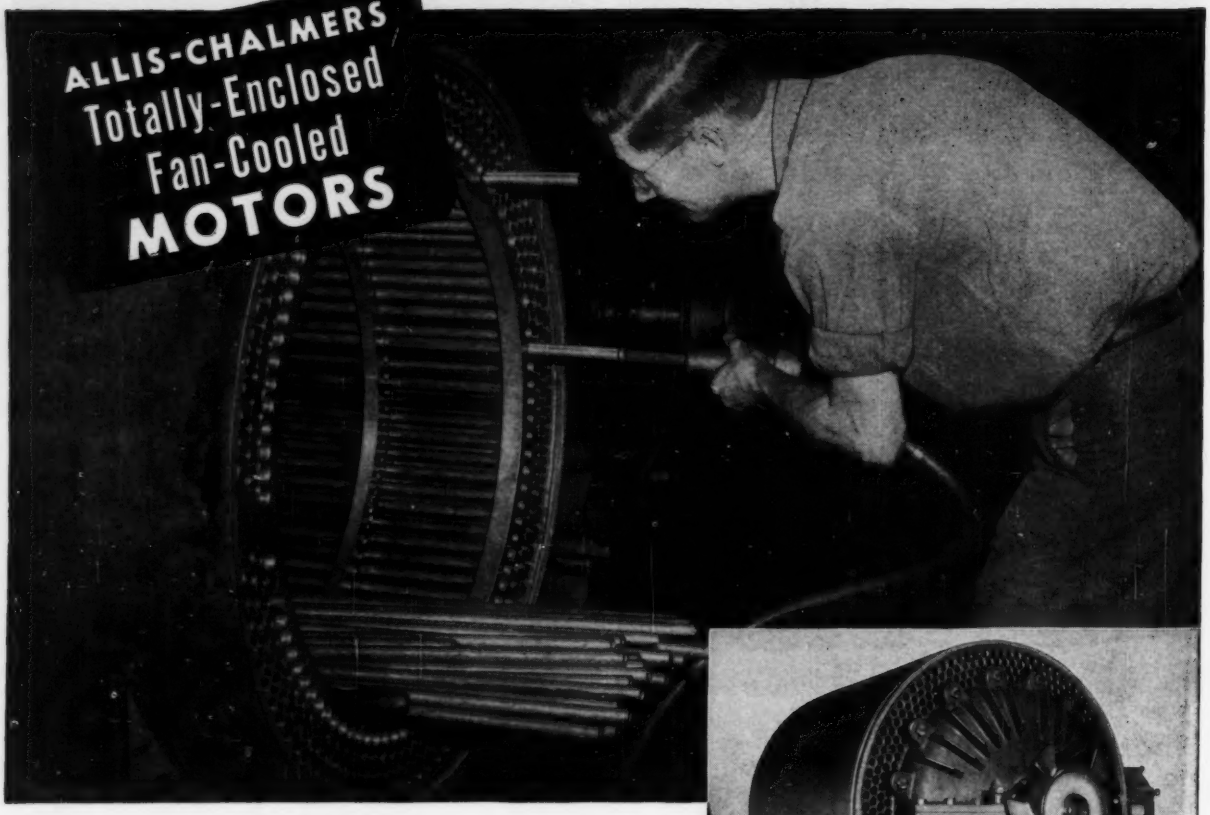
- Turbines rated close to your exact hp requirements, from 150 hp down to fractional. No need to buy a bigger, costlier turbine than your conditions call for.
- A larger number of steam nozzles, controlled individually by manually operated valves.
- Exclusive pilot operated excess speed safety trip supplementing constant speed governor.
- Replaceable cartridge type bearing housings.
- Optional carbon ring packing glands.

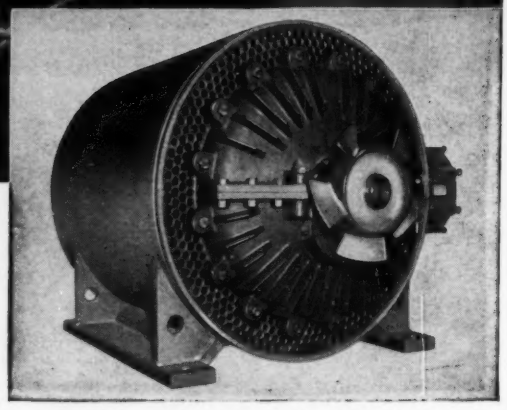
Coppus Steam Turbines ranging from 150 hp down to fractional, in 6 frame sizes, *make turbine dollars go farther.* Send for Bulletin 135 on Coppus Turbine.

COPPUS ENGINEERING CORPORATION
228 Park Avenue
Worcester 2, Mass.
Sales offices in
THOMAS' REGISTER



COPPUS "BLUE RIBBON" TURBINES





3600-rpm explosion-proof motor with fan housing removed to show unidirectional fan.

These heat exchanger tubes

Protect this motor from dirt and corrosion

COOLING AIR is carried through the heat exchanger tubes with sufficient velocity to expel practically all kinds of dirt. If oily or sticky dirt should cling, tubes can be ramrodded clean on the spot in a few minutes because tubes are straight and tube ends are exposed. Also, the tubes are distributed uniformly around the perimeter of the stator yoke and along its full length — cooling all parts of the motor evenly.

Choice of Corrosion-resistant Materials

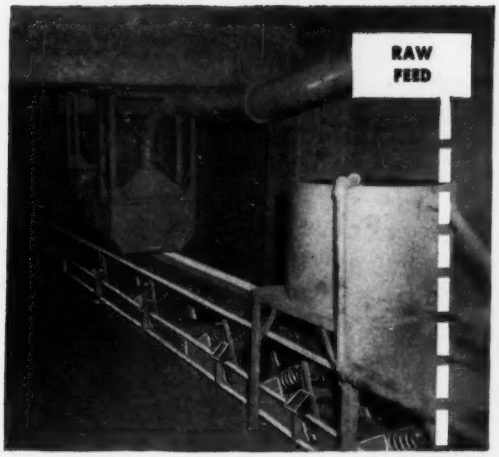
You can lick corrosion with this motor, too. Tubes are available in a variety of materials to meet practically any corrosive atmospheric condition. Allis-Chalmers tube-type motors have long and successful experience in such difficult applications as caustic plants, refineries and petrochemical plants, power plants with fly ash problems and many others.

Get Complete Information

Next time you need a motor for a dirty or corrosive location or for outdoor operation in all kinds of weather, call your Allis-Chalmers District Office. Get complete information on Allis-Chalmers tube-type totally-enclosed, fan-cooled and explosion-proof motors. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 51B7149. Available in ratings on frames larger than NEMA 505 up to 3000 hp.

A-4559

ALLIS-CHALMERS



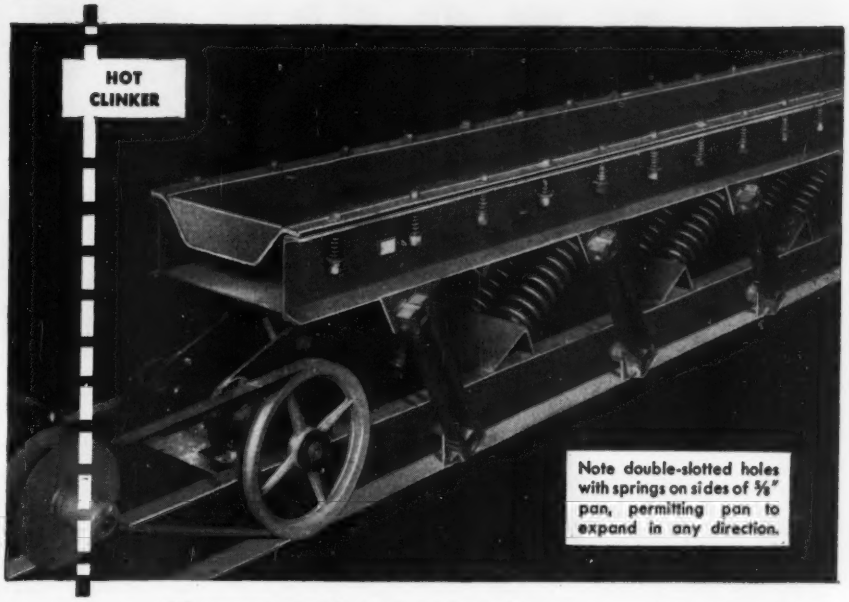
TOUGH CONVEYING JOBS ARE *DUCK SOUP* FOR CARRIER ~~NATURAL-FREQUENCY~~ CONVEYORS

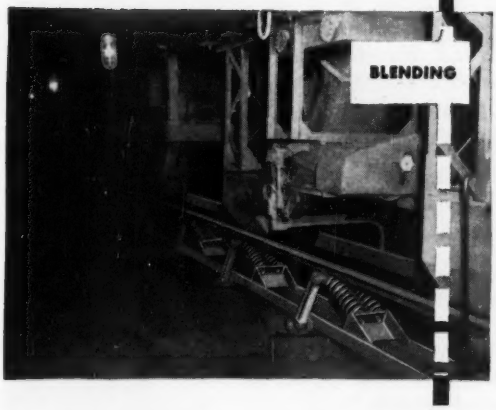
HIGH CAPACITY
Up to 80 tons per hour on 12" models!

HIGH TEMPERATURE
Up to 750° F. on standard models — 1600° F. on high-temperature models!

HEAVY-DUTY SERVICE
Pans up to ¾" plate!

LOW HORSEPOWER ASSURES LOW MAINTENANCE
1000 foot-tons per hour per H.P.!





The toughest job in a cement plant—*conveying and cooling hot clinker*—comes naturally to the rugged Carrier Natural-Frequency Conveyor shown above. By comparison, the raw-feed and blending operations are just plain duck soup, but Carrier Conveyors do all three jobs with equal ease and economy.

Cement-industry applications represent only a fraction of the many uses for Natural-Frequency Conveyors. These amazing conveyors are now moving scores of other hard-to-handle products—things like mill scale and slag . . . bulk chemicals . . . castings . . . food products . . . sand . . . machine turnings—conveying and processing them with spectacular success. If you handle anything hot, sharp, wet, brittle, abrasive, jagged or oily, it will pay you to get all the facts. Use the coupon, *today!*

Get the Facts Today!

Carrier Conveyor Corporation
231 N. Jackson St., Louisville 6, Ky.

Gentlemen: Without obligation, please send complete information on Carrier Natural-Frequency Conveyors.

Firm_____

Street_____

City_____ State_____

Att: Mr._____ Dept._____

FULTON SYLPHON

TEMPERATURE REGULATOR HEADQUARTERS,

Customer confidence has made Fulton Sylphon a leading supplier of temperature regulators . . . indeed, headquarters for temperature regulator know-how. Consider this extra advantage to you before buying any regulator.

You are confident of the right regulator for your requirement! Fulton Sylphon offers a complete line of temperature regulators for industrial process control; engine controls; heating, ventilating and air conditioning . . . provides latest engineering advances in efficient, lower-cost temperature control.

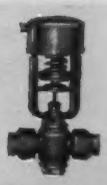
You are confident that the very finest engineering service is focused on your temperature control problem. Whether it involves field or plant engineering, your problem receives the prompt, specialized engineering service that only a leading supplier can afford to provide—without cost to you.

You are confident of dependable performance in the field. Fulton Sylphon Temperature Regulators are produced under the most rigid quality control standards. All parts are made by Fulton Sylphon to exacting, time-proved specifications. The diaphragm of each regulator is an all-metal Sylphon Bellows, originated by Fulton Sylphon and universally specified for the most critical military and industrial applications.

You are confident of competent, nearby field service. Fulton Sylphon technically trained representatives in 50 cities throughout the United States assure you of fast, on-call service.

Several types of Fulton Sylphon Temperature Regulators are described on the next page. For full information on these, and other types, use the convenient coupon.

New Fultrol—Thermostatic Pilot Controller No. 1100. Provides accurate control of liquids or air temperature when used in conjunction with valves, dampers, etc. Temperature ranges: 50°-250°F., 150°-350°F. Fast response. Low air or water consumption.

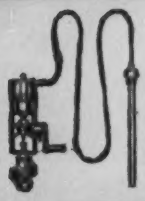


New Bellows Motor Valve—No. 992-D Series for final control element in pneumatic or hydraulic control systems to regulate flow of gas, oil, water or other liquids. Valve sizes ¼" to 4" inclusive. Ideal for use with Fultrol Thermostatic, Pilot Controller.

No. 999 Temperature Regulator—For accurate control of industrial process temperatures, storage water heaters, bottle washers, slashers, etc. Self-powered, sensitive, with over-temperature protection. Sizes ¼" to 4" inclusive.

No. 923-C Temperature Regulator—Extra large thermostat makes this unit more powerful than other self-operated regulators. Handles direct-operated valves on higher pressures and controls temperatures more closely. Sizes ½" to 6" inclusive.

U.S.A.



No. 923-Q Regulator—Quick adjustment type for controlling temperature of liquids, air or gases. For applications requiring frequent changes in temperature. Sizes ½" to 4" inclusive.

For Internal Combustion Engines—New Types 1280 and 1281 for control of cooling water or lubricating oil are powered by famous Fulton Sylphon Power-Pill thermostat units. Compact, easy-to-service, self-powered and simple to install.

New Hot-Cold Water Mixer—No. 1350 Series Mixers give an accurate, controlled source of tempered water. Unaffected by variations in water pressure. Failure of water supply automatically shuts off flow.

New Steam-Water Mixer—No. 1360 Series injects steam directly into the water, using every BTU of heat energy to bring water to a constant, pre-determined temperature. Steam is used only when water is drawn. Automatic shut-off if water supply fails.

Robertshaw-Fulton

CONTROLS COMPANY

Mr. Controls

FULTON SYLPHON DIVISION

Knoxville 1, Tennessee

☐ Have your representative call for appointment

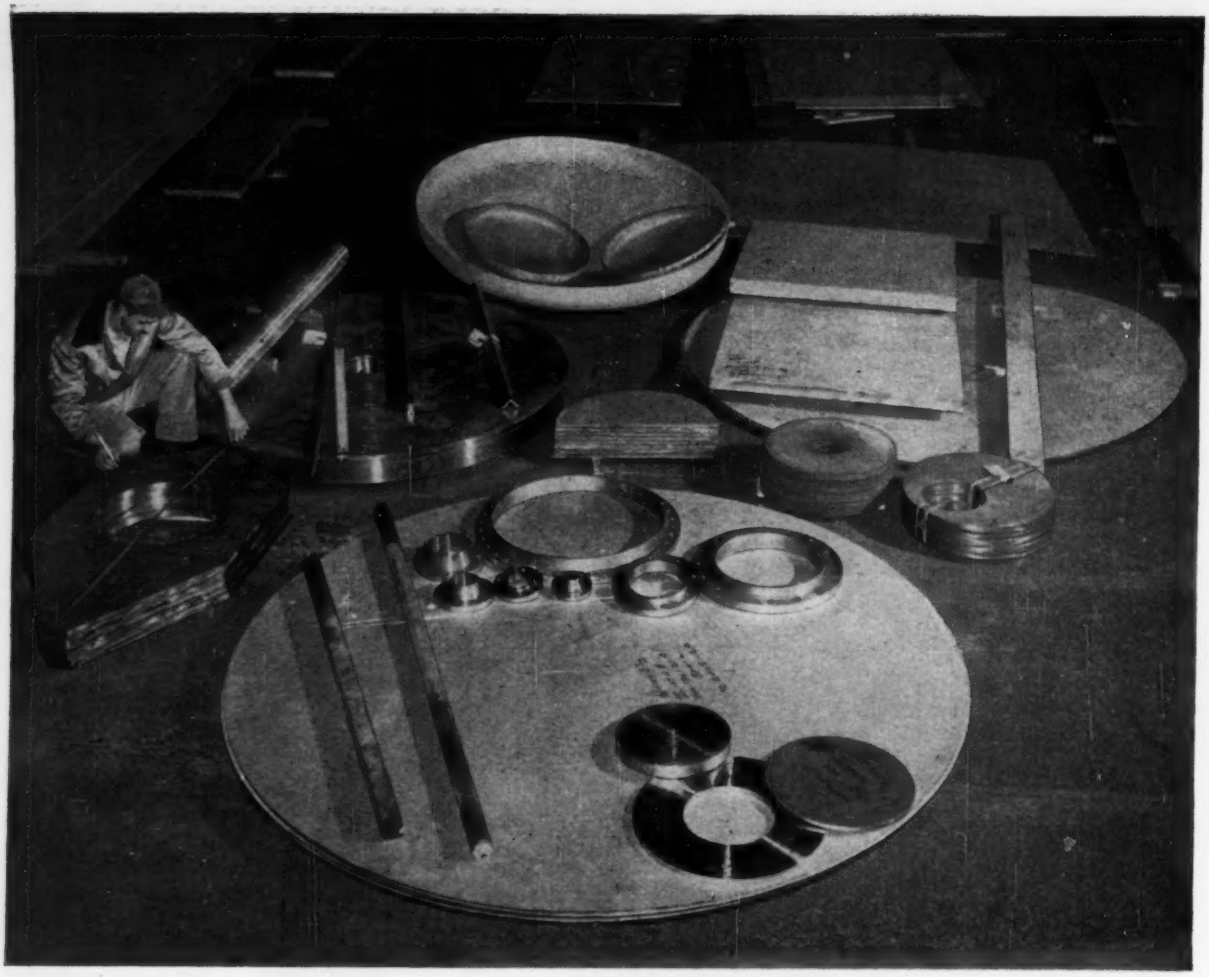
☐ Send literature describing Regulator Numbers: _____, _____, _____

Name_____

Company_____

Address_____

City_____ State_____



Delivery when promised . . . dependability in every piece . . . and economically produced in stainless steel

on Carlson Order No. 17656

Not every shipment is as diversified as GOC 17656 but it illustrates the typical all-around service in stainless steel available from G. O. Carlson, Inc.

There are plates, heads, rings, circles, flanges, bars and rounds—all stainless steel to chemical industry standards—all made to match the specifications on the customer's blueprint. It took special equipment to make up this order—equipment designed and built by Carlson engineers who work *exclusively* in stainless.

This equipment in the hands of Carlson specialists *lowers* costs. You pay no freight on material you can't use and you save man-hours in easier fit-up, because the material is ready for fabrication when you get it.

When you order your stainless steel from G. O. Carlson, Inc. you can be sure of three things: (1) it is economically produced from the highest quality material; (2) it is cut to your specifications; (3) it is shipped on time. Write *right now* for complete information.

Stainless Steels Exclusively

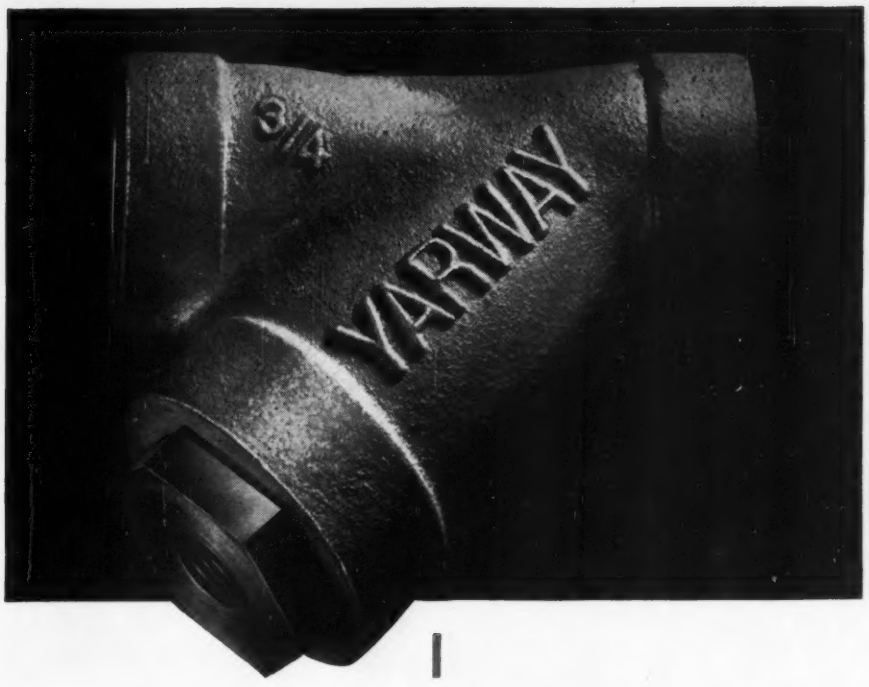
G. O. CARLSON, INC.

THORNDALE, PENNSYLVANIA

Plates • Plate Products • Forgings • Bars • Sheets (No. 1 Finish)

District Sales Offices in Principal Cities

USE STRAINERS?
USE YARWAYS



■ Use pipeline strainers in your plant? If so, you've plenty of reasons for using YARWAY Fine Screen Strainers.

Some of the reasons are these:

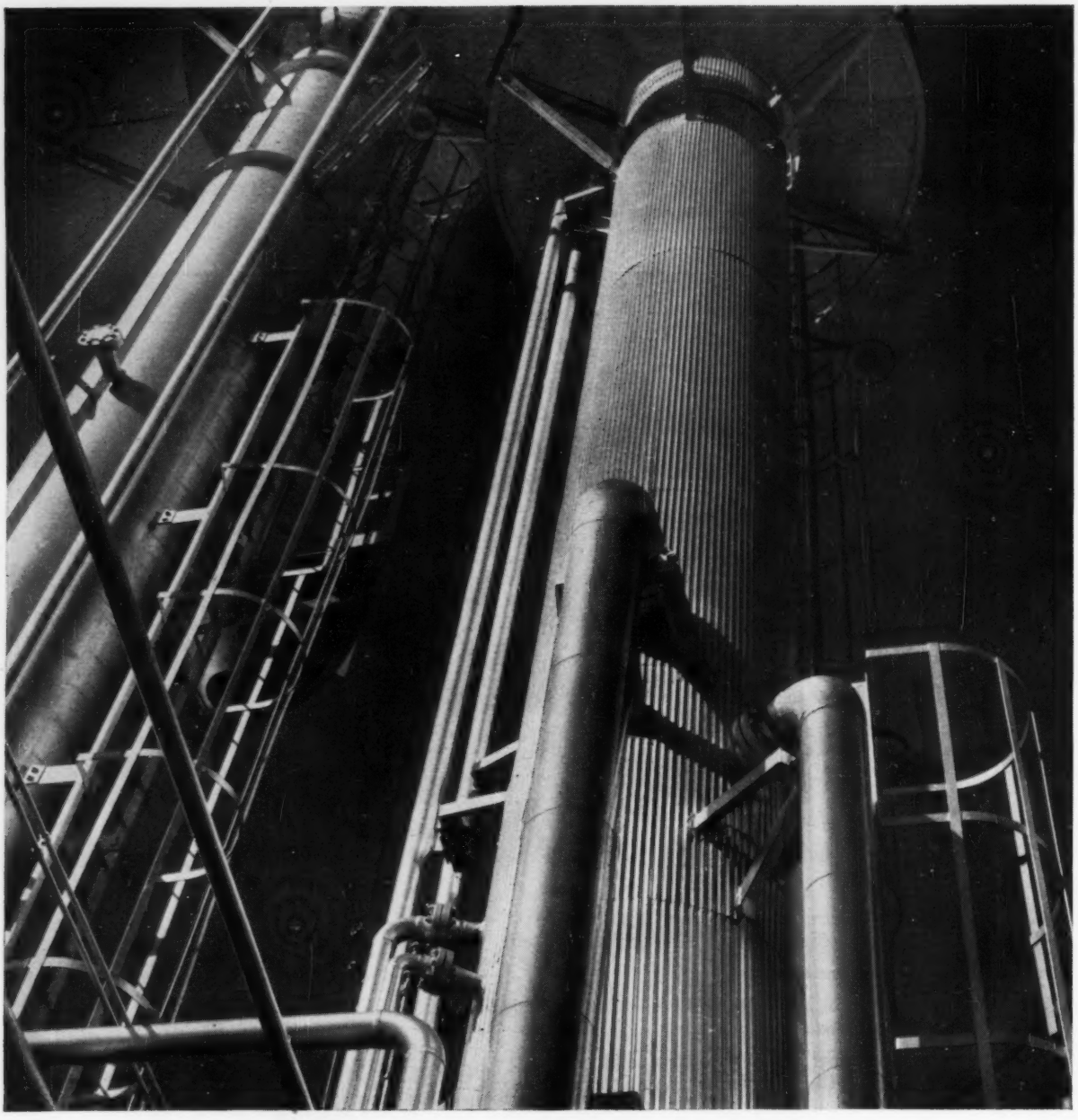
- Available in *iron* or *steel* with rust-resistant finish, also *bronze, stainless steel* and *aluminum.*
- Dutch weave Monel woven wire screens have high mechanical strength, extra fine straining service. Also perforated bronze, monel or stainless steel.
- Easy to remove screen caps with straight threads to assure proper alignment of screen.
- 10 standard sizes from ¼" to 3". Larger sizes to order. Also flanged and socket-weld connections.
- Stocked and sold by over 300 industrial distributors in the United States, Canada and abroad.

Write today for YARWAY Strainer Bulletin S-204, and name of nearest distributor.

YARNALL-WARING COMPANY
137 Mermaid Avenue, Philadelphia 18, Pa.

SCREEN EASILY REMOVED
Unscrew cap and screen comes out with it. When replacing, put screen in cap, then screw cap into body. Straight threads assure correct alignment, no screen distortion. Cap is tapped for pipe plug or blow-off line.

YARWAY FINE SCREEN STRAINERS



Unibestos® keeps 1175° where it belongs

Catalytic cracker...vacuum still and "poly" plant—all get added protection against heat loss with strong, single-layer Unibestos Pipe Insulation.

And Unibestos starts cutting costs right at the beginning. Unibestos, made of African Amosite, is easy to handle, easy to cut and miter. Long, interlacing fibers assure positive heat seals between sections...reduce pointing of joints...simplify insulation of fittings.

Built to resist thermal shock, vibration, and unaffected by most acid and chemical fumes, Unibestos can be easily removed and effectively reapplied when lines are relocated or replaced.

Standard Production Sizes

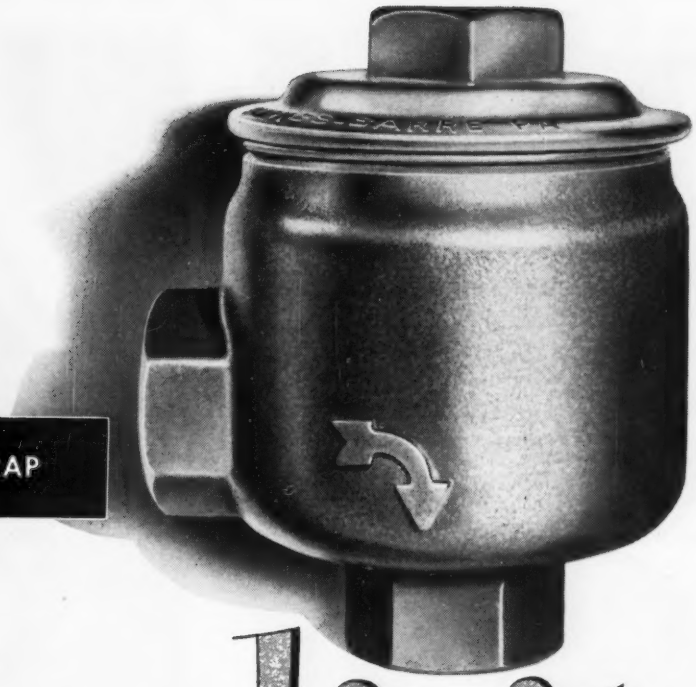
Unibestos Pipe Insulation is regularly made in 3-foot lengths for pipe sizes from ½″ through 24″, in standard thicknesses through 5″. Unibestos Block Insulation is made in 6″, 12″, 18″ or 36″ widths and in thicknesses from 1″ through 3″ in ½″ increments.

For complete information, write for descriptive Bulletin 109C

UNARCO®

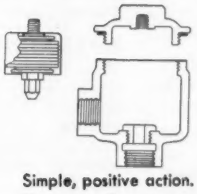
UNION ASBESTOS & RUBBER COMPANY

1111 West Perry Street • Bloomington, Illinois



STEAM TRAP

Simplicity



Simple, positive action. Has only three parts —thermostatic bellows, body, cap. Won't leak!

Nicholson simplicity. Pays off big in chemical processing—in peak performance, easy maintenance. Simple in design, simple in operation, Nicholson Industrial Traps prove the most effective method for discharging condensate and air from steam lines.

- **Fast, intermittent valve action.**
- **Tight, positive shut-off.**
- **No dribbling. No waste of steam.**
- **Low operating cost. Low maintenance.**

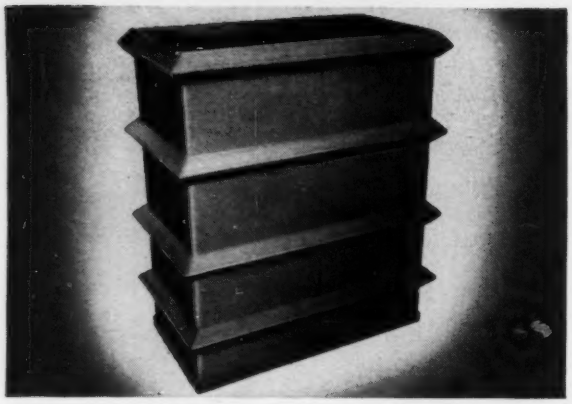
Before you specify, check Nicholson. Write for *Catalog 953*.

NICHOLSON

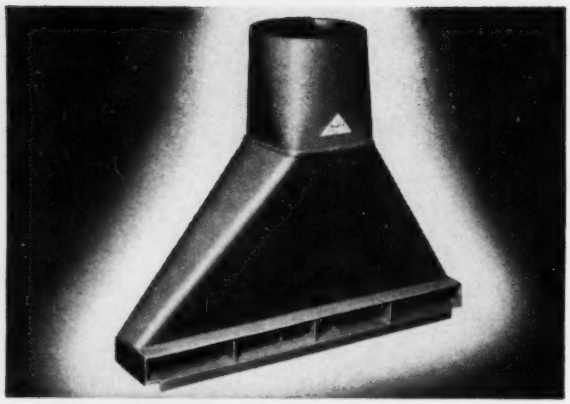
W. H. NICHOLSON and Company

TRAPS • VALVES • FLOATS • METAL PARTITIONS

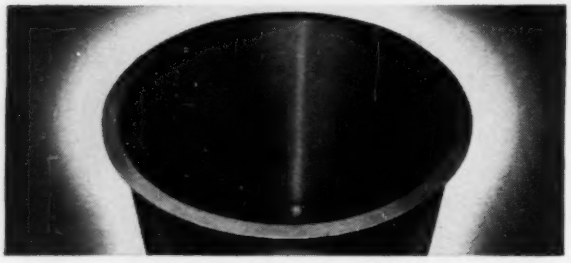
14 OREGON STREET, WILKES-BARRE, PA. • SALES AND ENGINEERING OFFICES IN 58 PRINCIPAL CITIES



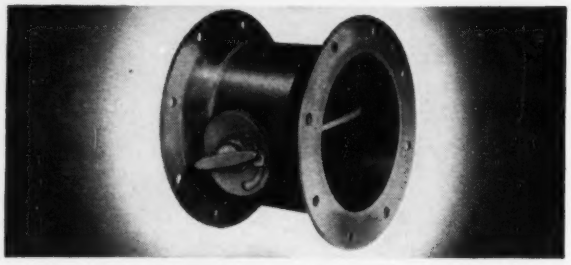
HAVEG 1810 PVC SELF-SUPPORTING TANKS offer maximum chemical resistance and mechanical stability. Individually designed with a wide margin of safety. Welded-on structural shapes guard tanks against deflection.



FUME DUCT MADE FROM HAVEG 1810 PVC is both low cost and planned to meet your system's needs. Haveg's Engineering Department works with you for simplicity of design, ease in shipping, installing, and maintaining.



HAVEG ALSO LINES TANKS WITH HAVEG 1810 PVC. Steel, wood or concrete tanks can be made serviceable, completely corrosion-resistant, with a tightly bonded PVC lining. Haveg uses a special PVC laminate, can do work in the field.



HAVEG FABRICATES PVC into special butterfly dampers that can be installed in either round or rectangular fume duct. Dampers are instantly adjustable and locked in place, contain few parts. Let Haveg make special items for you.

NEW, LOW COST CORROSION-RESISTANT EQUIPMENT

...made by HAVEG from Haveg 1810 POLYVINYL CHLORIDE

TRADE MARK REG. U. S. PAT. OFF.

Haveg, America's first molder of plastic corrosion-resistant equipment, now adds rigid, unplasticized polyvinyl chloride equipment . . . supplied in new Haveg Grade 1810 . . . to its complete line. The same Haveg fabricating skill, the same Haveg practical knowledge of corrosion engineering backs your order. Briefly, here is what Haveg has to offer:

CUSTOM FABRICATION of self-supporting tanks, steel tanks lined with PVC, complete fume removal systems from hood to weather cap. Haveg also makes angles and channel sections, troughs, flanges, pans, trays and dippers in Haveg 1810 PVC.

A trained Haveg engineer surveys your requirements, furnishes test samples, price and design information . . . tells you if PVC can save you money, help you fight corrosion better.

A COMPLETE INVENTORY OF STANDARD PVC ITEMS, ready for prompt delivery:

Sheet stock: in your choice of 144 x 44", or 72 x 44" size, in thicknesses of 1/16, 1/8, 3/16 and 1/4"; and in 60 x 48" size — 3/8, 1/2, 3/4 and 1" thick.

Bar stock: ten foot lengths from 1/4 to 2" diameters.

Pipe: Furnished in 1/2 to 6" diameters in 10 and 20' random lengths. Variety of ends, including plain, threaded, screwed flanged, welded flanged. Plain and socket-end PVC pipe is also made for cemented, or cemented and welded, installation. Complete line of pipe fittings are fabricated and stocked by Haveg. Maximum recommended working pressure for all pipe sizes: 25 psi at 75°F.

CHEMICAL RESISTANCE RATINGS show that Haveg 1810 has excellent resistance to acid attack, extending even to strong oxidizing acids in high concentrations. Resistance to alkalies and alkaline salts, as well as neutral and acid salts is very broad. With many organic compounds Haveg 1810 is completely satisfactory. Write for complete data.

OPERATING TEMPERATURES for most Haveg 1810 equipment is conservatively rated at 150°F. Remember, the complete line of Haveg equipment, including items using phenolic, furan, epoxy, polyester resins, now covers a working temperature range from 150 to 360°F.

WRITE FOR NEW HAVEG 1810 CATALOG which describes this new construction material, gives sizes and corrosion resistance information. Haveg gives you: Custom PVC fabrication. Complete stocks of standard items. Experienced corrosion engineering service. Design, engineering and installation skill. Call the Haveg engineer listed!

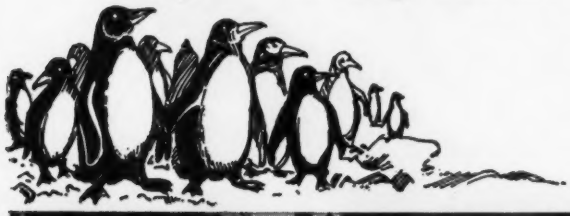
ATLANTA, Exchange 3821 • CHICAGO 11, Delaware 7-6088
CINCINNATI 36, Sycamore 2600 • CLEVELAND 20, Washington 1-8700
DETROIT 39, Kenwood 1-1785 • HOUSTON 4, Jackson 6840
LOS ANGELES 14, Mutual 1105 • ST. LOUIS 17, Mission 5-1223
WESTFIELD, N. J., Westfield 2-7383

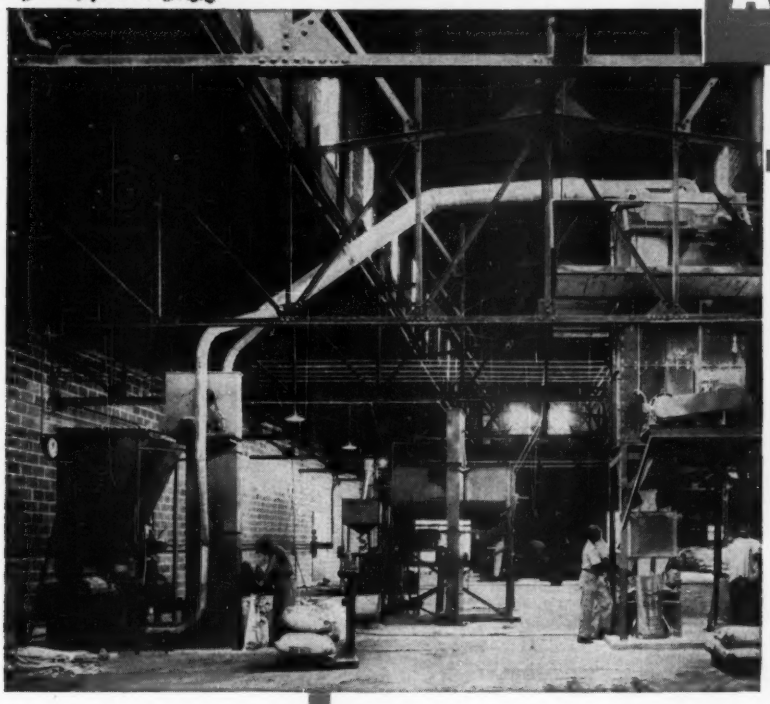
HAVEG CORPORATION

TRADE MARK REG. U. S. PAT. OFF.

900 GREENBANK ROAD • WILMINGTON 2, DELAWARE
FACTORY: MARSHALLTON, DELAWARE • WYman 8-8884

keep it cool, clean and "collected" with a MIKRO-AIRACON





Down-time gobbles up profits in a large commercial grinding establishment. The only answer is an automatic, dust-free system which can be speedily cleaned between runs of various materials.

This was the challenge met by our engineers when they devised the high-volume, low-suction MIKRO-AIRACON, shown above, for the B. K. Pancoast Company of Jersey City, N. J. The system, now installed in Pancoast's spacious new plant in New Orleans, La., grinds, air conveys and filters a wide variety of materials including spices, water soluble resins, adhesives and gums. It handles 3100 cfm and has a maximum output of 8,000 lbs./hr.

Raw material is lifted by bucket elevator to the large hopper which feeds the two MIKRO-PULVERIZERS in the extreme left foreground. Thence it is air conveyed via the overhead ducts to the MIKRO-COLLECTOR in the right foreground, which contains four felt filter cylinders policed by four reverse-jet cleaning rings.

What our engineers did for Pancoast, they may well do for you. If your problem involves grinding, air conveying or dust collection, why not submit it to our Laboratory today? It will cost you nothing and may mean the difference between profit and loss in your production.

SEND FOR descriptive illustrated bulletin

Mikro-D

PULVERIZING MACHINERY DIVISION
METALS DISINTEGRATING COMPANY, INC.
55 CHATHAM ROAD **SUMMIT, NEW JERSEY**

PULVERIZING • AIR CONVEYING • DUST COLLECTING EQUIPMENT

hang 'em ...and forget 'em

GRID
UNIT HEATERS

Trouble-free heating service in the... **Major Chemical Plants** *since 1929*

ABBOTT LABORATORIES	HOFFMAN La-ROCHE INC.
AMERICAN CYANAMID	MATHIESON CHEMICAL CORP.
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BUCKEYE COTTON OIL CO.	MONSANTO CHEMICAL CO.
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BENZOL PRODUCTS	STAUFFER CHEMICAL
DOW CHEMICAL CO.	SHARPLES CHEMICALS
MERCK & CO., INC.	PHILLIPS PETROLEUM
HERCULES POWDER	UNION CARBIDE & CARBON
COLUMBIA SOUTHERN CHEMICAL CORP.	VICTOR CHEMICAL WORKS
DAVISON CHEMICAL CORP.	HOOKER ELECTRO-CHEMICAL
DIAMOND ALKALI CO.	GENERAL ANILINE &
E. I. DuPont de NEMOURS, INC.	GENERAL CHEMICAL DIV. ALLIED CHEM. & DYE CORP.
HARSHAW CHEMICAL CO.	

NO Maintenance or Repairs

The reasons for this wide acceptance . . .

GRID'S All-Cast construction having similar metals in contact with steam prevents electrolytic corrosion.

GRID'S ability to withstand steam pressures up to 250# P.S.I.

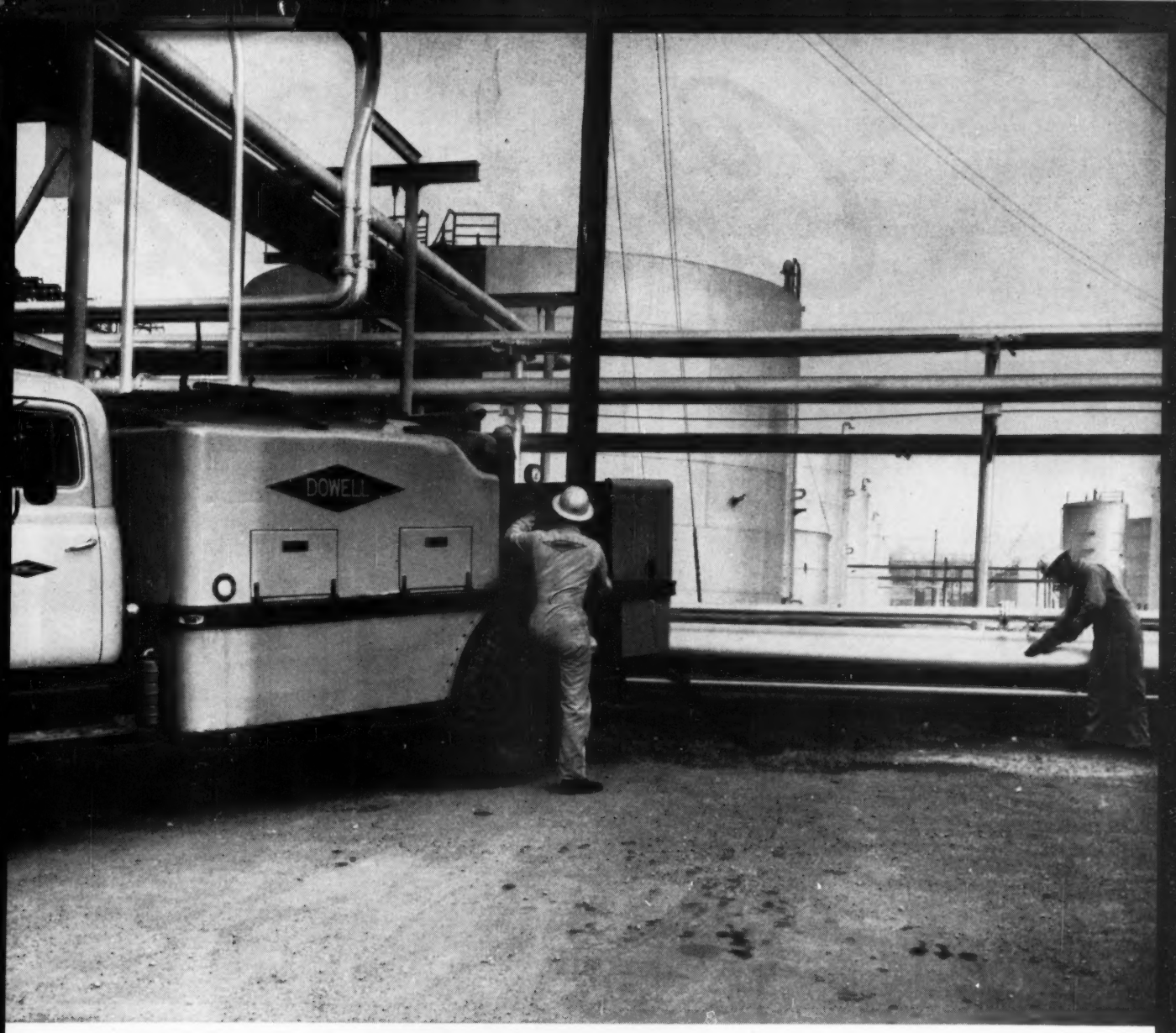
GRID'S low outlet temperatures, proper fan sizes and motor speeds assure delivery of warm comfortable air in ample volume, directly to the spot where it is needed. Maintenance cost conscious management men turn to GRID for relief from the continuous expense of heating failures experienced with ordinary unit heaters. GRID Unit Heaters installed in 1929 are still operating today . . . the only attention needed has been an occasional oiling of the motor. No ordinary unit heater can approach this record.

Get the full story today. Ask for booklet,
CORROSION IN UNIT HEATERS
. . . it's yours upon request.

D. J. MURRAY MANUFACTURING CO.

Manufacturers Since 1883 • WAUSAU, WISCONSIN

REPRESENTATIVES IN ALL PRINCIPAL CITIES



CHEMICAL CLEANING SAVED COSTLY LINE REPLACEMENT

After mechanical methods failed, DOWELL solvents removed thick scale from piping, restoring million-gallon capacity

During an oil refinery's annual turn-around, three weeks were spent attempting to clean a 20-inch water disposal line by mechanical methods. Each attempt failed to remove the scale, which ranged from 6 to 14 inches in thickness. Then—only seven days before the plant was scheduled to resume operations—Dowell was called. Dowell engineers used chemical solvents to restore the line's original capacity of 1,300,000 gallons of water per day. This job, which avoided a costly line replacement, took just six days.

Most Dowell jobs are completed within a few hours. Many lines have been cleaned without being taken out of operation at all. More time and expense are saved, too, because Dowell solvents are introduced through regular connections, avoiding costly dismantling and digging up of buried lines.

Then, too, Dowell solvents are designed to clean the *entire line*—bends, elbows, valves and any other hard-to-reach sections. Whenever the scale encountered makes it necessary, Dowell supplements chemical cleaning with pipe line pigs and jet moles.

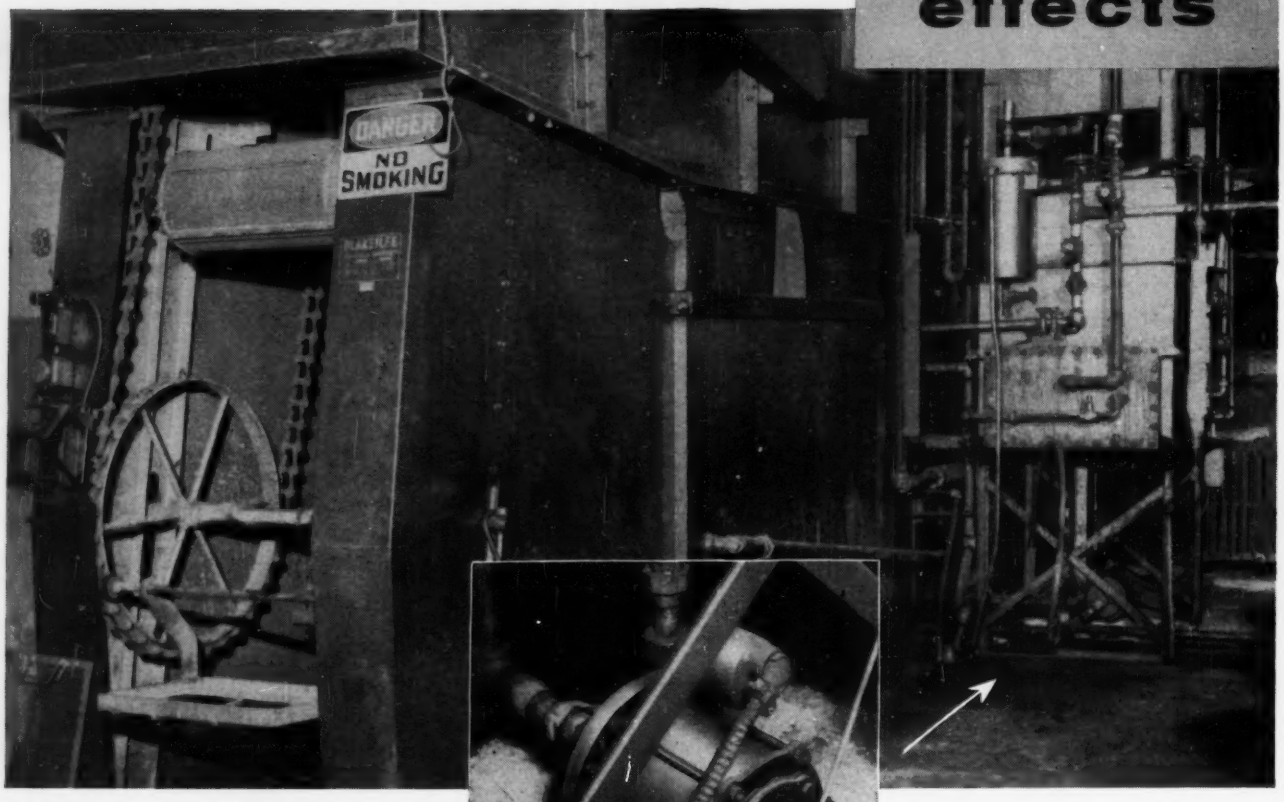
For the best solution to your industrial cleaning problems, call your nearest Dowell office. Or write Dowell Incorporated, Tulsa 1, Oklahoma, Dept. **H-33.**

chemical cleaning service for industry

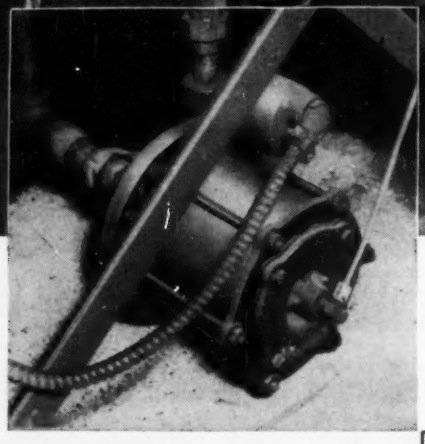
DOWELL

A SERVICE SUBSIDIARY OF THE DOW CHEMICAL COMPANY

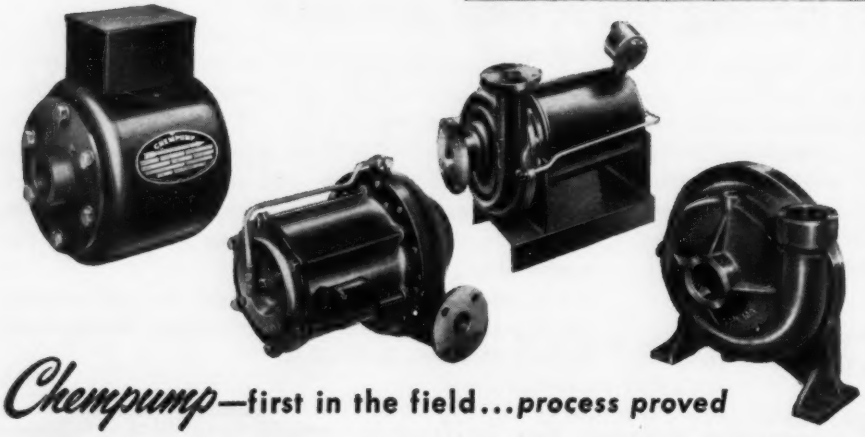
Chempump effects



Leak-proof *Chempump* handles trichlorethylene in this distillation-type degreasing unit at I-T-E Circuit Breaker Company.



Seal-less, totally enclosed pump operates against a 20-foot head, giving a capacity of about 25 gpm. Since installation of *Chempump,* not a single drop of trichlorethylene has been lost!



Chempump combines pump and motor in a single hermetic unit. Pumped fluid is allowed to enter rotor chamber of motor; no shaft sealing device is required. Pump impeller and rotor are an integral unit, isolated from stator section by a corrosion-resistant, non-magnetic liner. Pumped fluid cools bearings, rotor, and stator—and lubricates bearings.

Approved by Underwriters' Laboratories. Available in a wide choice of materials . . . from ⅛ to 7½ hp. Capacities to 250 gallons per minute. Heads to 195 feet.

Chempump can't leak!

***Chempump*—first in the field...process proved**

tremendous savings

at I-T-E Circuit Breaker Co.

Only Chempump seal-less pumps provide these cost-saving benefits:

- No seals, no stuffing boxes . . . can't possibly leak . . . end fluid losses.
- No lubrication, no external shaft, no coupling . . . virtually eliminate maintenance.
- No contamination of process fluids.
- Handle hazardous liquids with complete safety.
- Leak-proof under extreme vacuums or pressures.

Here's proof:

Savings of $45 a day in trichlorethylene *alone* (not to mention maintenance) are attributed to the leak-proof *Chempump* installed on a distillation-type degreaser at I-T-E Circuit Breaker Company, Philadelphia. With the ordinary centrifugal previously installed, the pump packings and packing lubricants were destroyed by the solvent. The shaft also scored repeatedly, intensifying packing problems.

Despite packing replacement with both standard and special packings, *two or three times a week,* the unit lost 25 gallons a day! Since installation of the *Chempump,* however, not a drop of trichlorethylene has been lost! The pump has operated for more than 4000 hours; the only maintenance—two quick bearing changes.

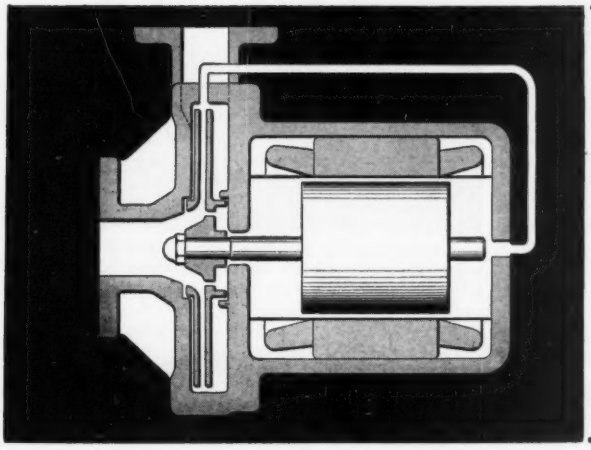
Combining motor and pump in a single unit, *Chempump* represents the most significant advance in pump design in half a century. Normally hard-to-handle fluids—volatile, toxic, corrosive, explosive, "hot," or sensitive—just can't leak or become contaminated! The only maintenance required is a simple bearing change—when required after periodic inspections—made without special tools . . . with only minimum down-time.

Here's just one more example of how *Chempump* has licked a tough leakage problem. Your process can benefit through *Chempump,* too. For details, send for new 16-page Bulletin 1010.

Engineering representatives in over 30 principal cities in the United States and Canada.

Chempump

CHEMPUMP CORP. • 1300 E. MERMAID LANE • PHILADELPHIA 18, PA.



CHEMPUMP CORP. • 1300 E. MERMAID LANE • PHILA. 18, PA.

Please send me details on *Chempump* for:

_____
(application)

Capacity _____ *Total dynamic head* _____

Name _____ *Title* _____

Company _____

Address _____

City _____ *Zone* _____ *State* _____

DOW

You Can See Why

SARAN LINED PIPE

is your answer to downtime losses

It's made of corrosion-resistant saran pipe swaged right inside rigid steel pipe . . . two pipes in one for longest-lasting performance.

Here's really trouble-free piping . . . saran lined pipe, fittings and valves! This modern piping has a durable inner lining that eliminates shutdowns due to corrosion . . . forms tight-fitting joints that prevent leakage. Saran lined pipe, fittings and valves won't burst under working pressures up to 150 psi . . . and saran lined cast steel fittings are available for even higher pressures. Every single piece of saran lined pipe, fittings and valves is carefully spark-tested by hand to be sure there are no pinpoint holidays or cracks in the lining.

Installation costs are low with saran lined pipe, fittings and valves, too. They can be cut and threaded in the field with modified pipe-fitter's tools. And because they're rigid, few supporting members are needed.

If your operation requires the conveying of acids, alkalies, solvents and other corrosive liquids, be sure to investigate saran lined pipe, fittings and valves today. For further information, write the Saran Lined Pipe Company, 2415 Burdette Avenue, Ferndale 20, Michigan, **Dept. SP-529A-1.**

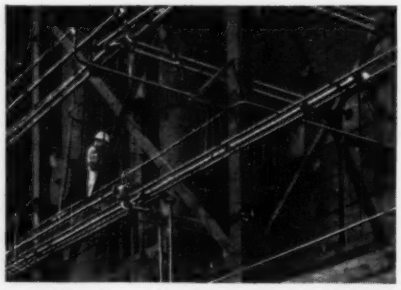
RELATED SARAN PRODUCTS—Saran rubber tank lining • Saran rubber molding stock • Saran tubing and fittings • Saran pipe and fittings.

SOME OF THE MANY INSTALLATIONS USING

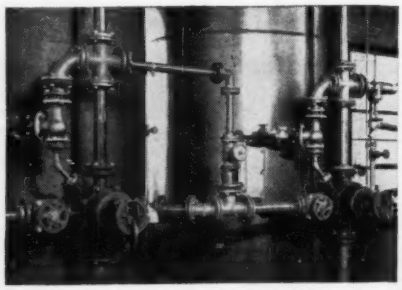
SARAN LINED

STEEL PIPE

Saran Lined Pipe is Manufactured by The Dow Chemical Company Midland, Michigan



Hydrochloric acid has been conveyed in this installation for well over seven years. Service has been eminently satisfactory.



Saran lined pipe is used here in an automatic water de-ionizer. This installation has also had a long record of uninterrupted service.

you can depend on DOW PLASTICS DOW

• *Stymied by a*
High-Temperature Barrier?

• *Looking for a*
High-Purity Material?

• *Searching for a material with*
Unusual Electrical Characteristics?

You may find the answer in this new booklet on NORTON Refractory Grain

This latest Norton publication is 8½″ x 11″. Twenty-four pages, with many charts, tables and photographs in color. A wealth of practical information on the nature, performance and application of refractory grains.

IF you're concerned with industrial processing involving temperatures ranging upwards to 4000°C and materials to contain your inferno — if you're looking for a high-purity material such as high-purity fused alumina for coating electronic heater filaments — if you're searching for a material with unusual electrical characteristics such as E 179 CRYSTOLON* Silicon Carbide for lightning arrestors — one of the many types of Norton Refractory Grain available may solve your problem.

This new booklet describes in detail Norton Refractory Grain — produced and purified in electric arc and high temperature resistance furnaces — which is helping industry to improve existing products and processes and to create new ones.

It's a valuable reference book with up-to-the-minute information on the chemical and physical characteristics of such materials as CRYSTOLON* Silicon Carbide, ALUNDUM* Aluminum Oxide, MAGNORITE* Magnesium Oxide, Fused Zirconia and Boron Carbide. In it you'll find data on how these materials are produced; their behavior under varying conditions; available grain size and applications.

These electrochemically refined materials may be just what you've been looking for to solve your problem. Write today for your free copy of "Norton Refractory Grain." NORTON COMPANY, Refractories Division, 507 New Bond Street, Worcester 6, Mass.

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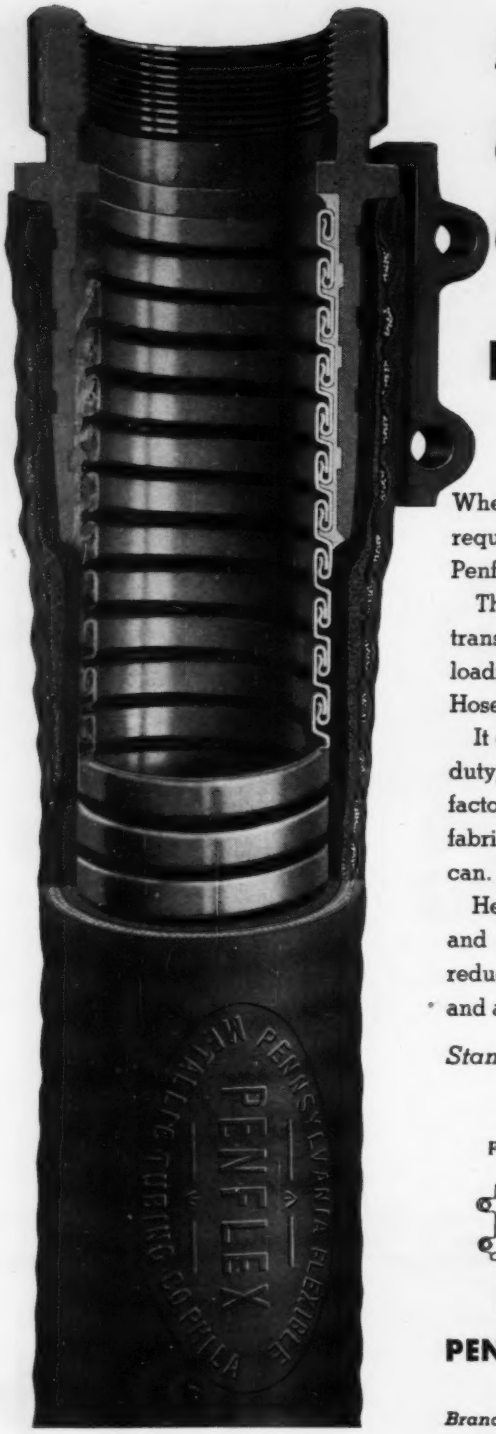
REFRACTORIES
Engineered... Rx... Prescribed

Making better products... to make your products better

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries



FOR LEAKPROOF... CRUSHPROOF TRANSFER OF VOLATILES AND GASES

Penflex Heavy Duty Suction & Discharge Hose

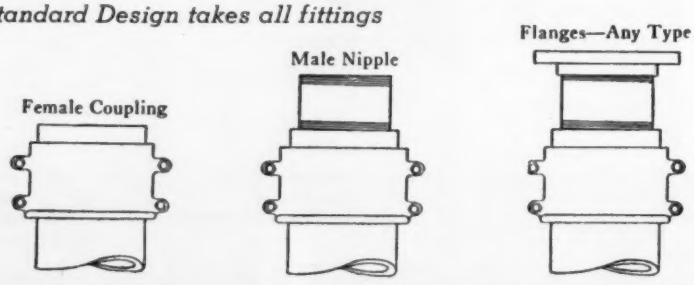
When the transfer of volatile liquids, highly penetrating oils, or gases requires a leakproof pipe and it must be flexible . . . your answer is Penflex Heavy Duty S & D Hose.

This flexible metal, plus rubber hose is outstanding for the routine transfer of hard to hold liquids and gases . . . for the worry-free loading and unloading of oils and gasoline. Penflex Heavy Duty S & D Hose is built to hold anything that will not attack metal.

It combines three way protection for volatiles and gases. The heavy duty, rugged protection of flexible metal hose with a working pressure factor of safety far under ultimate burst. An outer sheath of wire and fabric reinforced synthetic rubber made to take what any truck tire can. Plus the added inherent electro static protection.

Here is a suction and discharge hose made to outwear . . . outlast . . . and outperform all others regardless of construction or make. To reduce hose replacement costs . . . speed loading and unloading . . . and assure leakproof transfers specify Penflex Heavy Duty S & D Hose.

Standard Design takes all fittings



PENNSYLVANIA FLEXIBLE METALLIC TUBING CO.

7234 Powers Lane, Philadelphia 42, Pa.

Branch Sales Offices: Boston • New York • Chicago • Houston
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PENFLEX

HEART OF INDUSTRY'S LIFE LINES

DARCO Digest

CHEMICALS DEPARTMENT
ATLAS POWDER COMPANY, WILMINGTON 99, DELAWARE
ATLAS POWDER COMPANY, CANADA, LTD., BRANTFORD, CANADA

Treatment with activated carbon ends troublesome foaming

Unwanted foam can cause plenty of trouble in numerous production processes . . . for example, by hampering mechanical mixing, scrubbing, or evaporation. There are several ways to tackle the job of removing these trouble-makers. One of the most efficient ways is to treat with activated carbon.

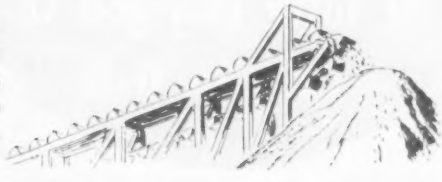
The reason that certain materials cause foam is that they are surface active. This characteristic makes them a natural for adsorption by activated carbon . . . for surface active materials are readily attracted to and held by the large interfacial area offered by the carbon.

Note that carbon treatment stops foam by *taking out* the guilty contaminant, in contrast to the use of foam suppressors which add another impurity to combat the one that is already present. The carbon, of course, comes out in filtration, taking with it the foaming agents. Because it does not add new materials to the solution, carbon treatment is especially useful when working with solutions that need to be maintained at high levels of purity.

Here are two typical examples of how Darco activated carbon has been put to work at reducing foam:

In butadiene production, an ammoniacal copper scrubbing solution developed foam during continued usage . . . to the extent that the process often had to be shut down. Percolating the solution through Darco removed the foam-causing ingredient, and eliminated this production problem.

Impurities in a trona deposit caused excessive foaming that hindered the concentration of soda ash from this raw material. Treatment with Darco helped materially to end this foam, at economical cost.



The Darco treatment is capable of close control. For example, brewers use Darco to remove haze-forming proteins *without* affecting the foaming properties of the beer. The trick is to use a small dosage that is just barely enough to take out the even more adsorbable proteins causing haze on chilling . . . without depleting the ingredients of the beer that give desirable foam.

If you're worried about a foam problem, write to us. We've helped a lot of people, and we'll be glad to offer recommendations on your specific application.

Removing trace impurities by resinification

Minute quantities of phenol which occur as impurities in chemical products can be removed by the use of activated carbon, by applying a basic principle that works in a number of different purification problems.

The principle is to form a large, complex molecule of limited solubility. Because of its size, and because it is ready to fall out of solution, this molecule is readily adsorbed by the carbon.

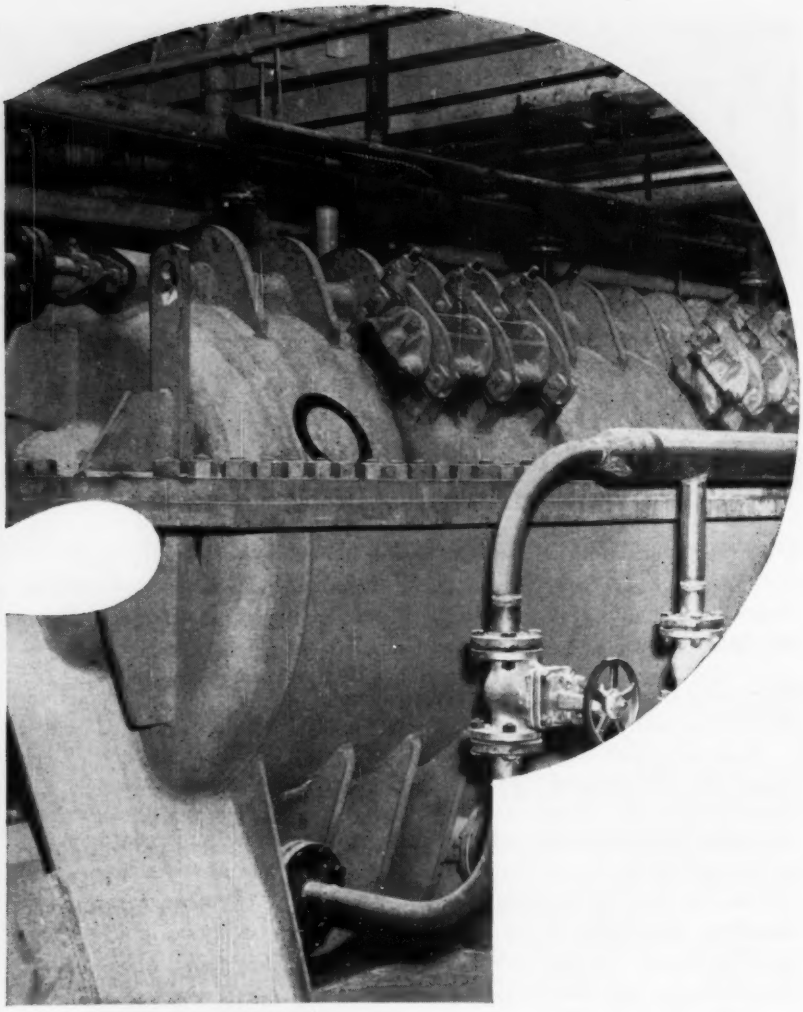
In the case of trace phenol, the first step is addition of formaldehyde. The resulting phenol formaldehyde may not be present in sufficient concentration to agglomerate and precipitate out, as it does in the familiar condensation reaction. However, the large surface area offered by the carbon gives the process a boost in this direction. The complex molecule is readily adsorbed.

Similarly, traces of aldehydes can be made adsorbable by treating with phenol. The resulting compound is then removed by carbon dosage.

Purification by this technique can generally be done if the reaction takes place in water, at low concentrations and at room temperature. We'll be glad to offer recommendations on your particular application.

We'll GUARD your Confidential Process Problems...

while we help you solve them!



HERE'S A CASE where another big company had complete confidence in G-B . . . our ability to solve a tough problem, and keep it confidential.

The filter, in this particular process, was designed and engineered to filter salt from a highly viscous material under very high pressure and temperature . . . complicated by the presence of a highly caustic solution. It has a filtering surface of 738 square feet, and will meet A.S.M.E. code requirements for pressures up to 150#. The filter uses a precoat . . . the cloth can be readily replaced by the customer. G.B. filters of this type are available in all welded nickel and stainless steel construction . . . with solid or clad shell and solid filter element.

If it's a **FILTERING OR EVAPORATING PROBLEM** —and a tough one... it will Pay you to talk to **G-B**

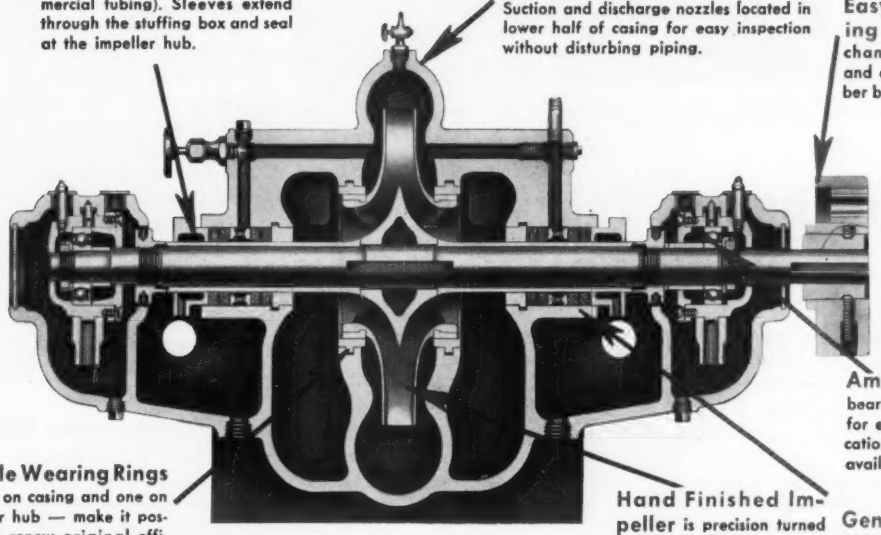
G-B engineers have a wealth of filtering and evaporating "KNOW-HOW" you can use. They will consult with you, *without obligation*, to help you solve your problems. They will help you run tests in your own plant . . . or you are welcome to use G-B's own complete testing facilities.

GOSLIN-BIRMINGHAM MANUFACTURING CO., INC.

BIRMINGHAM • ALABAMA

Get 8 Advantages of GOOD PUMP DESIGN

ALLIS-CHALMERS
Double-Suction
PUMPS



Longer Shaft Sleeve Wear with cast shaft sleeves (not commercial tubing). Sleeves extend through the stuffing box and seal at the impeller hub.

Greater Rigidity with heavy horizontally split cast-iron casing construction. Suction and discharge nozzles located in lower half of casing for easy inspection without disturbing piping.

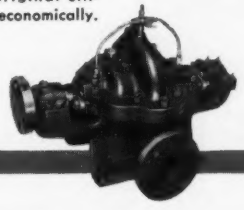
Easy Coupling Mounting with *Magic-Grip* quick change bushings for pump and drive shaft. Pin and rubber bushing type usually used.

Ample Bearings — Ball bearings may be furnished for either oil or grease lubrication. Split shell bearings also available in larger sizes.

Double Wearing Rings — one on casing and one on impeller hub — make it possible to renew original efficiency easily and economically.

Hand Finished Impeller is precision turned and carefully balanced to assure vibrationless operation and close wearing ring clearance.

Generous Stuffing Box with sufficient packing to keep stuffing box maintenance low. Provision made for sealing water connection or grease seal if required.



Wide Choice of Materials is available for all types of service — iron, bronze, stainless steel and combinations.

HEAVY DUTY CONSTRUCTION with no skimping, no corner cutting is what you'll find in Allis-Chalmers double-suction pumps. Extra metal thicknesses, extra strong parts, extra features and extra careful workmanship add up to long life, low maintenance, and low cost per gallon pumped.

Every Allis-Chalmers double-suction pump is carefully tested on the most modern testing equipment in the industry. Each installation is individually engineered by men whose experience in thousands of pump installations will give exactly the right pump for your needs. Stock sizes from 10 to 7000 gpm with heads to 475 feet.

Complete Pumping Unit

Allis-Chalmers can furnish the complete installation — pump, motor, control and drive — all built of coordinated design and manufacture.

Whatever your pumping problem, call your A-C Authorized Distributor or District Office. Or write Allis-Chalmers, Milwaukee 1, Wisconsin, for Bulletin 08B6146.

A-4590

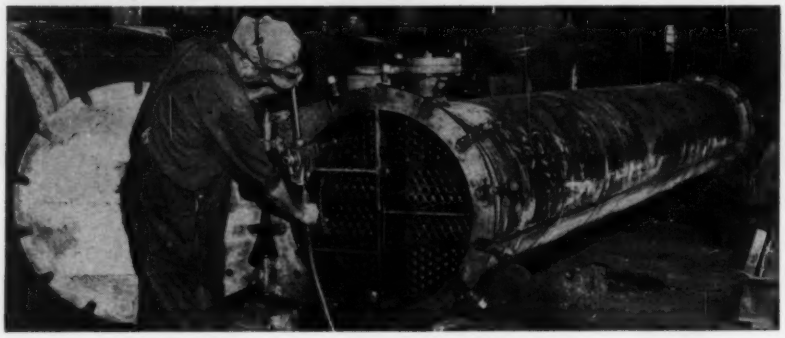
ALLIS-CHALMERS

BRIDGEPORT BRASS COMPANY

CONDENSER AND HEAT EXCHANGER TUBE EDITION

COPPER ALLOY BULLETIN

Bridgeport Brass Co. MILLS IN BRIDGEPORT, CONN. AND INDIANAPOLIS, IND.—IN CANADA: NORANDA COPPER AND BRASS LIMITED, MONTREAL



By combining two metals, Bridgeport Duplex Tubes successfully combat double-source corrosion in this heat exchanger.

Bridgeport Duplex Tubes Resist Dual Corrosion

Preventing tube corrosion, when inside and outside media are different, is a problem of prime importance to industries where heat exchange, condensation and cooling are necessary operations.

Bridgeport's advanced research and manufacturing processes have proved the answer to this dual-source corrosion... Duplex Tubes. These are dual-walled tubes made of the two metals which most successfully resist corrosion from both internal and external sources.

Combining copper and copper-alloys with ferrous and other nonferrous metals permits Duplex Tubes to be tailored to the individual application. The results are:

1. Long-term savings in reduced frequency of retubing.
2. Longer equipment life.
3. Less frequent equipment shutdowns.
4. Improved heat transfer properties.
5. Reduction of undesirable or dangerous product intermixing.

Wide Range of Applications

Proof of the success of Bridgeport Duplex Tubes in overcoming the problem of dual-source corrosion is the wide acceptance they have found in greatly diversified applications. Oil refineries, coke by-product plants, synthetic rubber plants, and many other specialized industries have found Bridgeport Duplex Tubes the answer to their dual-corrosion problems.

In the oil and natural gas industries, several varieties of Duplex Tubes have given improved performance over single-walled tubes. Examples are Duplex Tubes with steel outside to resist various corrosive petroleum vapors and copper alloy inside toward the fresh water; steel outside against the oil and Admiralty, Aluminum Brass or Cupro-Nickel inside toward circulating salt water. Others are alloy steel with copper alloys, aluminum with copper or brass, either inside or outside.

In the coke by-product and synthetic rubber industries where ammonia refrigeration plays a vital part, Duplex Tubes have been supplied composed of copper to water side, where it gives superior service, and steel to the ammonia side, to resist corrosion from that source. Were either metal to be used alone in a single-walled tube, frequent tube replacement would be necessary.

In chemical plants producing colorless formaldehyde, Duplex Tubes have been supplied having Admiralty outside for brackish water and aluminum inside to prevent product contamination. Other combinations for different processes also have proved superior.

In boilers and steam generators, Duplex Tubes with copper exteriors and steel interiors are used successfully. Hot gases pass through the steel and water surrounds the copper. In addition to longer service life from reduced corrosion, higher efficiency is made possible because copper-steel Duplex Tubes have better heat transfer qualities than ordinary steel tubes with the same wall thickness.

Duplex Tube Specifications

For condenser and heat exchanger applications, Duplex Tubes naturally conform to condenser tube specifications for size and composition. Generally supplied in straight lengths up to 30 feet, outside diameters range from one-half inch to three inches, and total wall thicknesses from .049" to 3/8".

On thinner gauges, wall thicknesses of these tubes generally are divided equally between the two metals. On thicker gauges, the copper-base alloy or stainless steel component may range in thickness from 1/3 to 1/5 of the total. End-annealed tubes also are supplied.

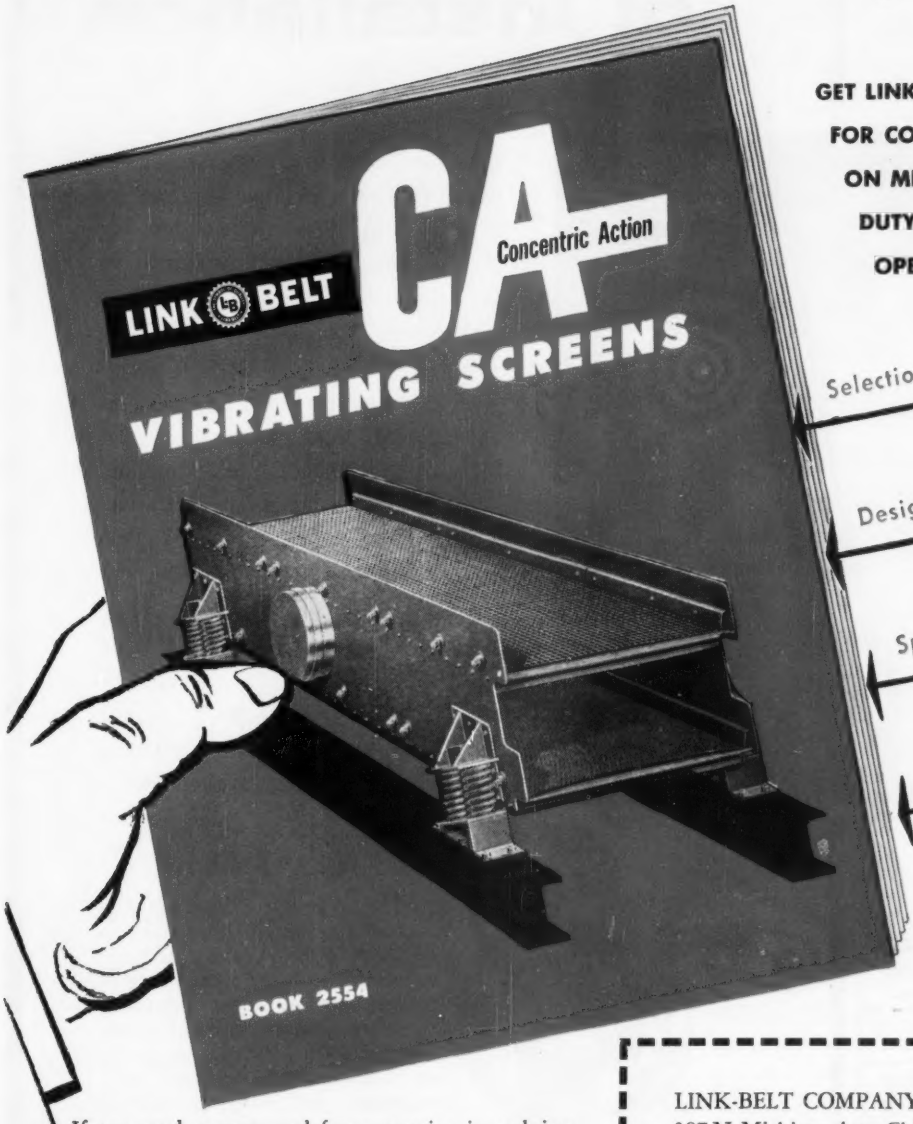
Temperature Effects

Questions occasionally arise in regard to the effects of extreme temperatures on Duplex Tubes because of their bimetal nature. Service experience has proved that Duplex Tubes are satisfactory under such conditions.

Tubes comprising materials with widely different coefficients of thermal expansion, such as copper-base alloys and steel are giving very satisfactory service in condensers, coolers and heat exchangers, where temperature of the tube ranges from 0°C to 100°C and even higher. Of course, tube temperature often does not reach that of the surrounding chemicals.

To assist condenser tube users in solving their corrosion problems, Bridgeport's Research Laboratory and Technical Service have compiled a wide background of experience and knowledge. The benefits of this background are available to you by calling your local Bridgeport Sales Office. Helpful information on Condenser Tube alloys, Duplex Tubes, corrosion of all types and other subjects are contained in the Bridgeport Condenser Tube Handbook. A copy of this useful 156-page book will be sent to you on request. (3330)

NEW! Comprehensive guide to Concentric Action Vibrating Screens



GET LINK-BELT BOOK 2554 FOR COMPLETE INFORMATION ON MEDIUM AND HEAVY DUTY SCREENING OPERATIONS

- Selection
- Design features
- Specifications
- Installations

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If you need accurate and fast separation in scalping, sizing, dewatering and rinsing materials . . . you'll want Link-Belt Book 2554. This comprehensive catalog contains full information on Link-Belt Concentric Action Vibrating Screens . . . types, features, capacities, selection and application data. Send for your copy today.

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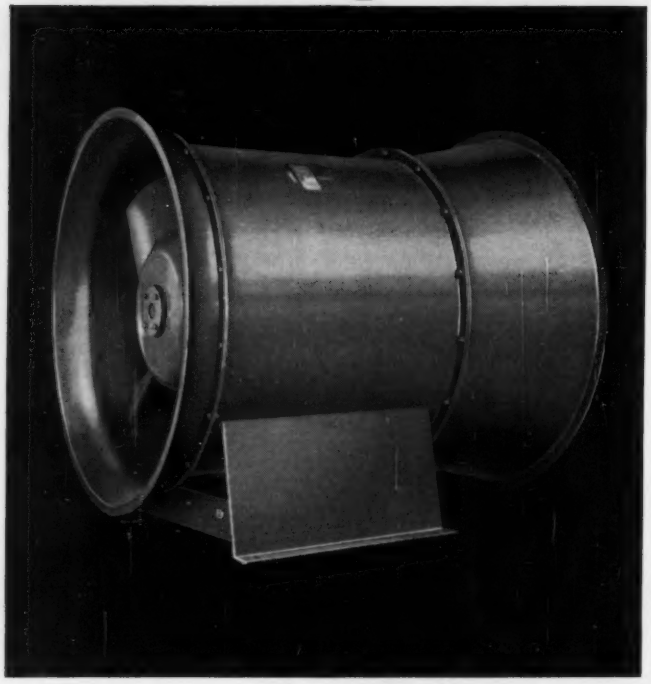
American Blower
Axial Fans
offer you

Unusual ease of installation



Because American Blower Axial Fans have cylindrical casings, you can install them in ductwork in a number of positions. This feature results in savings in handling and installation costs while the straight line airflow and universal mounting save space.

Available in either tubeaxial or vaneaxial design, American Blower Axial Fans are compact, self-contained units; occupy minimum space. Capacities range from 2,500 cfm to 75,000 cfm with either direct or V-belt drives.

Contact your nearest American Blower Branch Office for full data on axial fans or other air-handling and conditioning products. A trained sales engineer will help you select and apply the proper equipment.

CERTIFIED RATINGS
Certified ratings are the result of tests made by the Manufacturer in accordance with the Standard Test Code for Centrifugal, Axial, and Propeller Fans adopted jointly by the National Association of Fan Manufacturers, Inc. and the American Society of Heating and Ventilating Engineers.
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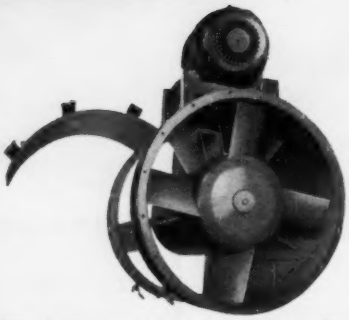
Certified Ratings
All deliveries are in accordance with Standard Test Code for Centrifugal and Axial Fans adopted by Canadian Fan Manufacturers and American Society of Heating & Ventilating Engineers.
CFM



Two large access doors in the fan casing allow speedy inspection and cleaning.

Spray Booth Fan

The Spray Booth Vaneaxial Fan combines the efficiency and flexibility of the Vaneaxial Arrangement 9 with the convenience of two large, quick opening access doors in the fan casing. In addition to the doors, the design includes specially arranged guide vanes and increased running clearance between blade tips and casing to prevent clogging.

American Blower products serve industry

AIR CONDITIONING, HEATING, VENTILATING EQUIPMENT
MECHANICAL DRAFT EQUIPMENT
INDUSTRIAL FANS AND BLOWERS
CENTRIFUGAL COMPRESSORS
GYROL FLUID DRIVES
DUST COLLECTORS

AMERICAN BLOWER CORPORATION, DETROIT 32, MICHIGAN
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AMERICAN BLOWER

Serving home and industry: AMERICAN-STANDARD • AMERICAN BLOWER • CHURCH SEATS & WALL TILE • DETROIT CONTROLS • KEWANEE BOILERS • ROSS EXCHANGERS • SUNBEAM AIR CONDITIONERS

Here's An Unbeatable Combination For Displacement Type Liquid Level Control!

It's The BS&B Type 888 Liquid Level Controller With The Type 1450 Liquid Level Control Pilot!

Used Throughout The Refining, Chemical, Power And Special Products Industries!

- ✓ Torsion tube assembly eliminates objectionable packing glands and pressure type bearings.
- ✓ Ground Joint Seal.
- ✓ Operates on liquid specific gravities from .2 to 2.0, using standard displacement elements.
- ✓ Control Pilot opens from left or right, as convenient.
- ✓ Calibrated proportional band to 100%.
- ✓ Snap or on-off action may be set at points spread to as much as 75% of the displacement element's range.
- ✓ Specific gravity index is provided for compensating for the various gravities of liquids, or for inter-face gravities.

For Better Regulation of Pressures, Temperatures, Liquid Levels or Flow, Equip Your Process With BS&B AUTOMATIC CONTROLS and SAFETY HEADS!

EFFICIENCY OVER 60 YEARS BS&B RELIABILITY ANOTHER EXAMPLE OF PRODUCT LEADERSHIP

If You'd Like More Detailed Information, Contact Your Nearest BS&B Representative, Or Write To . . .

BLACK, SIVALLS & BRYSON, INC.

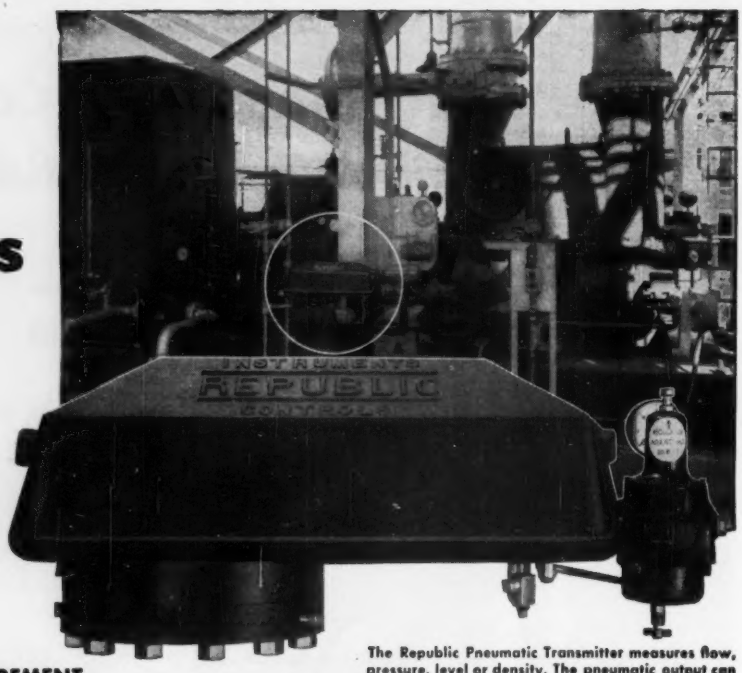
Controls Division, Dept. 4-N8

7500 East 12th Street Kansas City 26, Missouri

Republic

PNEUMATIC TRANSMITTERS

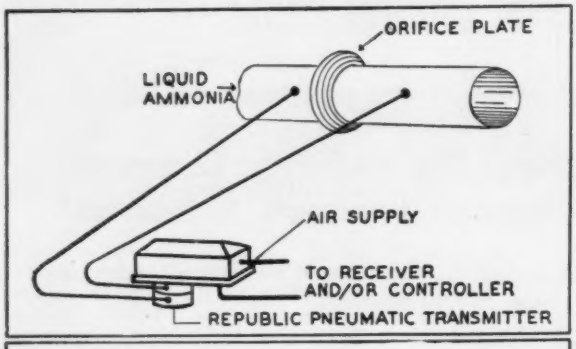
. . . Your Best Solution to Tough Metering Problems Like These:



The Republic Pneumatic Transmitter measures flow, pressure, level or density. The pneumatic output can be used to operate reading instruments and as the measuring impulse to an automatic controller.

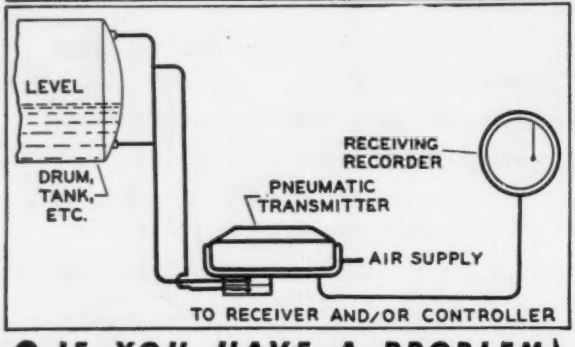
LOW DIFFERENTIAL FLOW MEASUREMENT

When pressure drops in flow lines must be kept small—as in the discharge of blowers—low range Republic Transmitters offer the most practical answer to flow measurement. For *only* with Republic Transmitters can you get differential ranges as low as 0-0.6-in. H_2O at static pressures to 15 psi and 0-2.5-in. H_2O at pressures to 1000 psi. This low range feature permits the use of devices producing a minimum differential; accurate force-balance measurement and control is possible with back-pressure on blowers, for example, held to a negligible figure.



METERING VAPOROUS LIQUIDS

Repulic's low ranges provide the key to successful measurement of easily vaporized liquids, too. Take the flow of liquid ammonia through an orifice as an example. By using an orifice producing a small differential drop, you avoid flashing the liquid into gas and getting an inaccurate measurement. And since the Republic Transmitter is a force-balance instrument, there are no problems of liquid seals, purging or overrange blowing the sealing liquid into flow lines.



LIQUID LEVEL MEASUREMENTS UNDER PRESSURE

This job requires an instrument with a narrow range span and considerable range suppression. High pressure, low range Republic Transmitters are available for just this kind of measurement. For accuracy and close control, range suppressions up to four times the range span are possible i.e., a Republic Transmitter with a 0-100-in. H_2O range can be suppressed to operate between any 20-in. H_2O span within the full 100-in. range.

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involving the measurement of
FLOW, PRESSURE, LEVEL OR DENSITY
with pneumatic transmitters . . .

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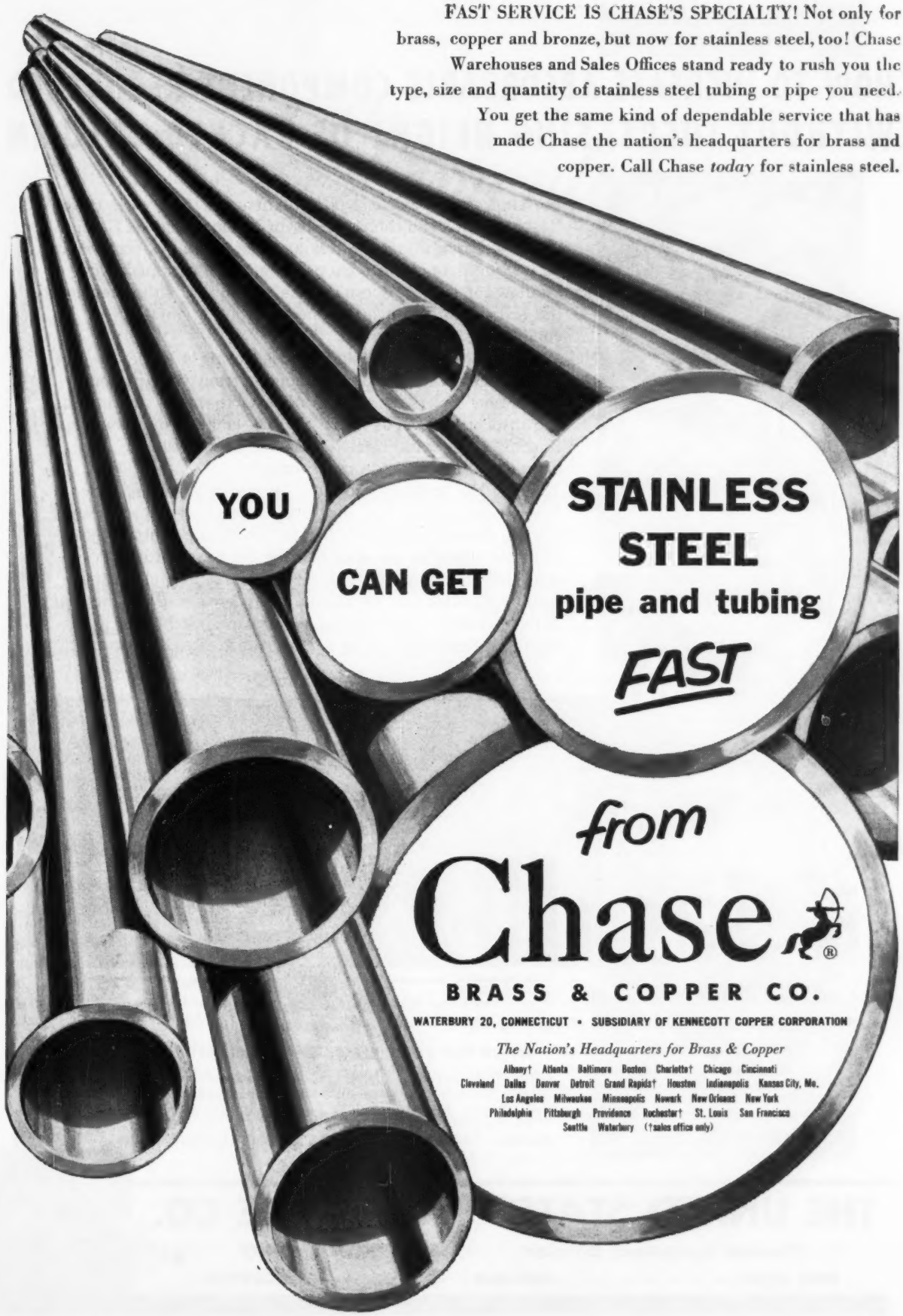
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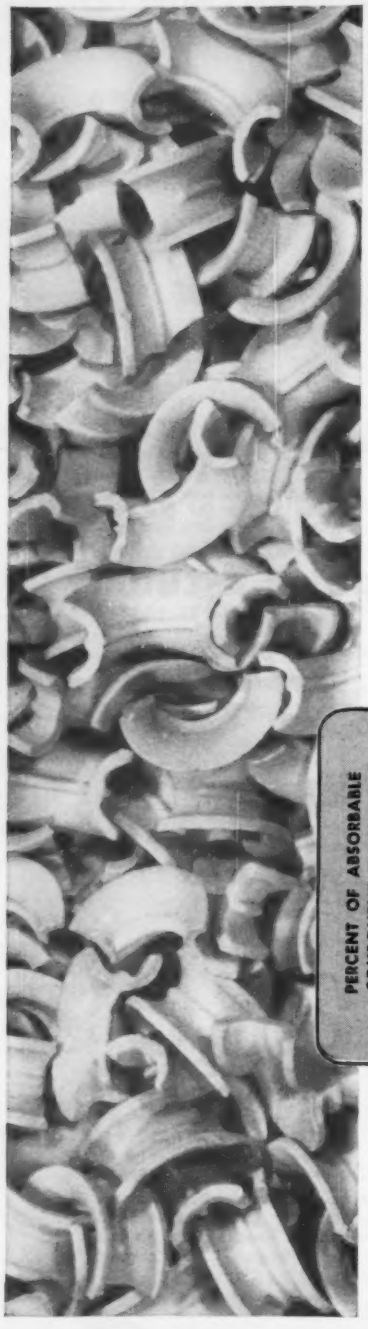
HOW TO INCREASE ABSORBABLE COMPONENT RECOVERED WITHOUT INCREASING HEIGHT OF PACKED COLUMN

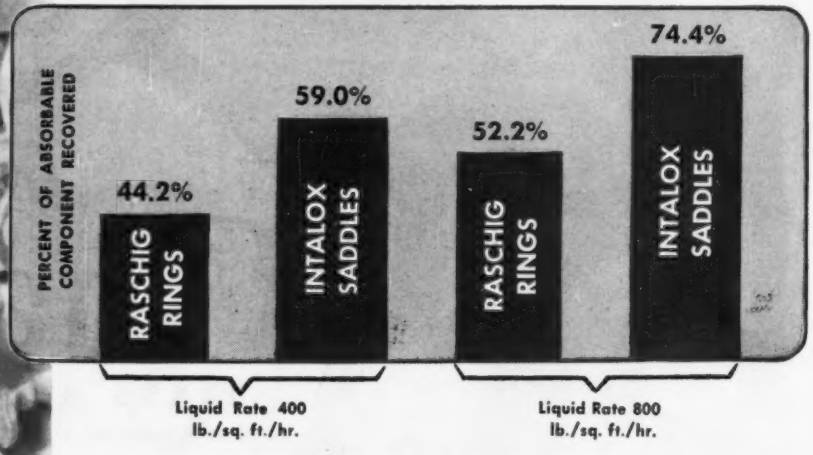


We alternately packed a pilot plant tower first with 10′ of Raschig Rings and then with 10′ of Intalox Saddles. Using identical gas and liquid rates and the same gas composition, absorption data for the two packings were obtained. One swallow, of course, doesn't make a summer, so we repeated the test again and again to be sure our original conclusions were justified.

If you're facing the problem of recovering a higher percentage of absorbable component from your present absorption towers, *it appears obvious* that you can increase the absorption level as much as 30% or more by replacing Raschig rings with Intalox Saddles. And without changing either liquid or gas rates!

Turning the problem around — if you're planning new tower construction for absorption operations — it appears *equally obvious* that tower height can be substantially less If Intalox Saddles are specified for the tower filling.

Actually, the increase in absorption level through using Intalox Saddles can be substantially greater than the test data indicates — for Intalox Saddles permit higher liquid and gas rates to be carried before flooding occurs.



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Gives full technical data and specifications on Intalox Saddles, including comparative charts showing relative pressure drops, flooding limits, gas pumping costs, etc.

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Process Equipment Division **AKRON 9, OHIO**

NEW YORK **CHICAGO** **HOUSTON**

AUGUST 1955

Chementator

Edward T. Thompson

● **Ethylene from gas oil via a modified Wulff process developed by California Research is being considered by Oronite Chemical for its proposed Perth Amboy, N. J., plant (Chementator, June 1955).**

● **Hooker Electrochemical, just-merged with Durez Plastics & Chemicals, is now negotiating a merger with Niagara Alkali.**

● **Add a uranium-from-phosphate-rock process to Davision Chemical's stable and expect its early entry in the rare earths race.**

New diammonium phosphate process

There's more activity in diammonium phosphate, this time at Missouri Farmers Assn.'s new $5 million, 200-ton/day fertilizer plant at Joplin, Mo. It's the first to use a new Dorr-Oliver process that starts with wet process phosphoric acid.

DAP technology has been plagued by two big problems: First, how to use cheap, wet-process acid containing aluminum and iron impurities which form gummy, hard-to-handle precipitates. Pure furnace acid gets around this, but it's more expensive. Secondly, how to keep down ammonia losses aggravated by the high ammonia concentrations needed (compared with making monoammonium phosphate).

TVA has been studying this for some time, and just recently announced a crystallization process. Dorr's technique is quite different.

At Joplin, DAP is made by a modification of the standard mono process. Wet-process acid (32% P_2O_5) is added to the first of three agitated tanks in series. Ammonia goes in at two stages. From the third tank comes a slurry—20% water—containing a 20-80 mixture of mono- and diammonium phosphate. All impurities are also precipitated.

Ammonia loss is kept down by using a liquor concentration with a high ammonia absorption capacity and by an efficient scrubbing system for recovery and recirculation of ammonia. Granulation of the DAP, addition of other solid components and drying gives a complete fertilizer mixture.

At TVA, ammonia and phosphoric (24% P_2O_5) are reacted under conditions that just precipitate the metallic impurities as phosphates. These are filtered out and the filtrate is treated with more ammonia in a vacuum crystallizer fitted for ammonia recovery. The slurry of crystals is centrifuged, the metallic phosphates put back in and the mixture is dried.

Dorr thinks its design is cheaper than TVA's and if you compare the two flowsheets, this appears true. For Dorr avoids two costly operations—filtration of impurities and vacuum crystallization.

Shale oil update: Big plant started

Shale oil can compete with crude oil, believes Union Oil Co. And backing this up, the firm has begun construction at Parachute Creek, Colo., of the first big U. S. oil-shale retort. Capacity will be 1,000 tons of shale daily; design is the same as Union's 50-ton/day pilot plant.

Three months ago it looked like the company's plans would be much delayed. At that time Union thought it couldn't afford to put in its own mine and tried to work out a plan to get shale from the Bureau of Mines. Recently, however, Union informed the Bureau that such a plan was unnecessary.

Shale will be retorted near the mine site and the crude oil will be coked. Coke distillate, after

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hydrogenation to remove sulfur and nitrogen, would go to the West Coast for normal refining.

Union's ultimate aim is to build a full-scale plant. Latest cost estimate for a 40,000 bbl./day installation, including mines, is $75 million; a 50,000 bbl./day pipeline to Los Angeles would cost about $56 million. At these figures, says Union, the oil could be delivered in Los Angeles at a cost competitive with current crude prices.

Ante raised in cat cracker suit

Houdry Process Corp., which had been suing Socony Mobil Oil Co. for $27.1 million for infringing catalytic cracking patents, has upped its claims for damages to nearly $52.8 million. At issue are two catalytic cracking processes: Houdry's Houdriflow and Socony's air-lift Thermofor Catalytic Cracking (TCC).

Houdry charges that Socony, formerly a one-third owner of Houdry, violated both confidence and contracts with Houdry in licensing the air-lift TCC, alledgedly infringing 11 Houdry patents and copying the Houdriflow process. Also, Houdry now says Socony conspired to destroy the Houdry company and seize its business. This last is based partly on Socony's cutting royalty rates by 60%; Houdry felt forced to meet the lower rate and now wants $16 million in damages on that count.

Socony counters that the suit apparently is an attempt by Houdry to obtain title to important inventions developed in Socony laboratories, inventions which were made available to the world "on fair and equitable terms." Of Houdry's new move to increase the damages, Socony says: "The allegations . . . appear to be as groundless as those in the original complaint." Socony also has asked that Sun Oil be made a party to the suit in view of the latter's interest in Houdry.

More agreement on power reserves

Congress is joining electrochemical producers in worrying about future power reserves. As a result, government agencies with fingers in the electrical planning pie have stopped trying to discredit each others' figures and are now working on a single, unified plan.

And the figures will be vital to makers of such products as aluminum, hydrogen peroxide, rayon and phosphorus, who bought 1.84 billion kwh. more from the government in 1954 than in 1953.

With much electrochemical industry centered in the Northwest and Southeast, predicted shortages in those areas have added significance. In the Northwest, says the Federal Power Commission, 1954's 9.3% reserve will drop to 2.5% this year and to a 1.3% deficit in 1958. In the Southeast, reserves will drop from 16.4% to 0.7% in the same period. However, the Interior Dept. disagrees with these estimates. It feels they would come true only in case of adverse weather and that they don't include already-planned capacity.

With their expansion plans tied so directly to power estimates, process firms would give a sigh of relief if government authorities can agree on a single projection. As things look now, federal officials will ask industry's help, calling on top executives both of electric utilities and power consumers to take part in the survey.

Olefins from resids by coking

Whether you want olefins for petrochemicals or a way to upgrade residual oils for cat cracking, you'll do well to check into a new continuous coking process developed by Farbwerke Hoechst in Germany. There's no word yet on licensing possibilities, but pilot-plant results were so good that Hoechst is going commercial at Frankfurt.

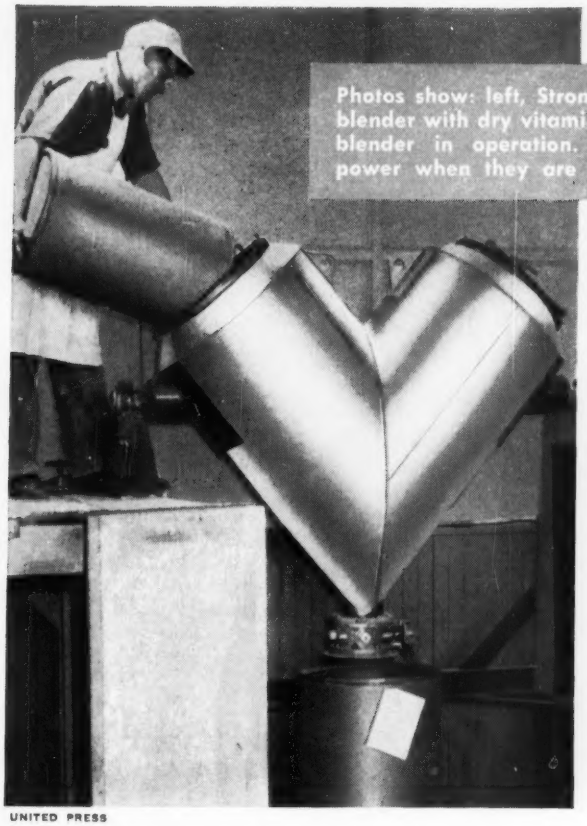
To get high yields of olefins from crude oil or heavy residual fuels, very high reaction and regeneration temperatures are needed. (Hoechst reacts at about 1,300 F.) With U. S. processes such as Lummus' Contact or Esso's Fluid Coking, the regeneration step forms carbon dioxide and water; but at very high temperatures the equilibrium shifts to CO and hydrogen, consuming much of the coke.

Hoechst says its moving bed process gets around that problem: Coke pebbles are indirectly heated in tube bundles, then mixed with preheated feed, the main reaction taking place immediately. Coke produced forms thin deposits on the pebbles and matures—attains minimum content of hydrogen and volatiles—in the main reaction space. Reaction products are quenched and fractionated.

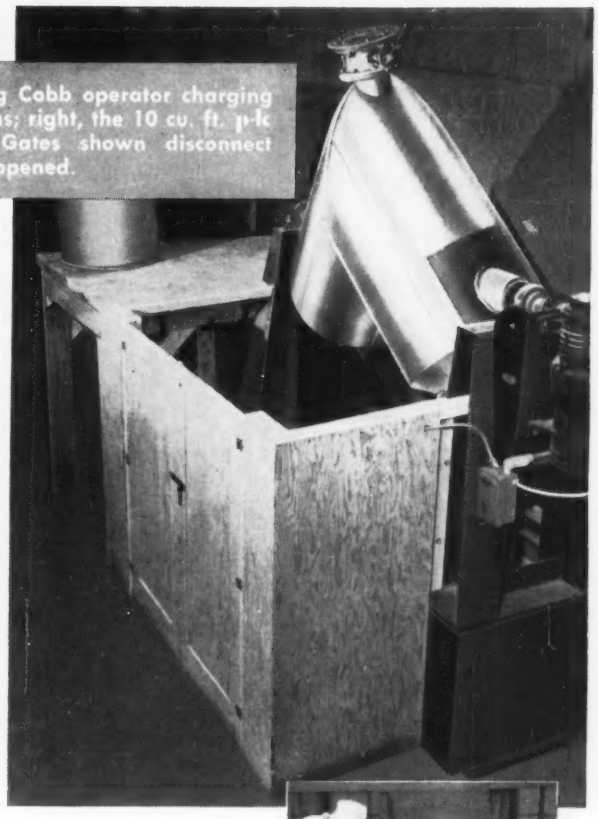
Coke pebbles are steam-stripped, then elevated to the top of the unit by lift gas, such as nitrogen, hydrogen or a light hydrocarbon. (Use of ethane as lift gas, for instance, would boost total yields of unsaturates.)

Experimental yields are typified by this run on crude oil: Gaseous hydrocarbon make, C_4 and lighter, was 55.3 wt.% of the feed. Of this, 58.8% was olefinic. Liquid product and coke yields were, respectively, 38.2 and 6.5 wt.% of the feed. Yields

(Continued on page 108)



Photos show: left, Strong Cobb operator charging blender with dry vitamins; right, the 10 cu. ft. p-k blender in operation. Gates shown disconnect power when they are opened.



UNITED PRESS

How STRONG COBB & CO. CUT DRY BLENDING TIME BY 90%

Dry ingredients blend thoroughly and uniformly in **p-k** twin shell blenders* in only 1/10 the time required by other dry blenders, according to Strong Cobb & Co., Inc., Cleveland. They also pointed out that **p-k** twin shell blenders are much easier to clean than other blenders.

Strong Cobb manufactures drugs and pharmaceuticals to private formulas. Thorough blending, consistant uniformity from batch to batch, and clinical cleanliness are, of course, all-important to such products.

"We would recommend the twin shell blenders to others," say Strong Cobb. "For all types of mixes, they are fast, clean and positive. Loading and unloading is quick and easy."

Your mixing operation may call for a standard **p-k** twin shell dry blender, screw-feed or intensifier model. Perhaps a double cone or ribbon blender may be right for you. Because **p-k** manufactures all three kinds, you can be sure of impartial information to help you select the right blender to fill your needs.

Write now for Catalog No. 12, which includes complete engineering data —or send samples of materials for analysis of blending.

* Patented

"Cleaning is no problem," according to Strong Cobb. Here a worker washes out a 50-cu. ft. **p-k** blender. Twin shell blenders have no inside baffles to trap material.

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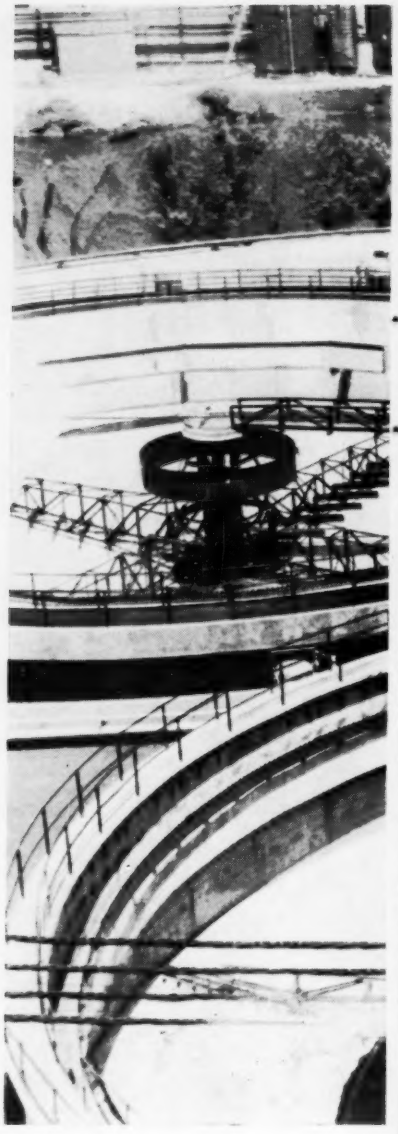


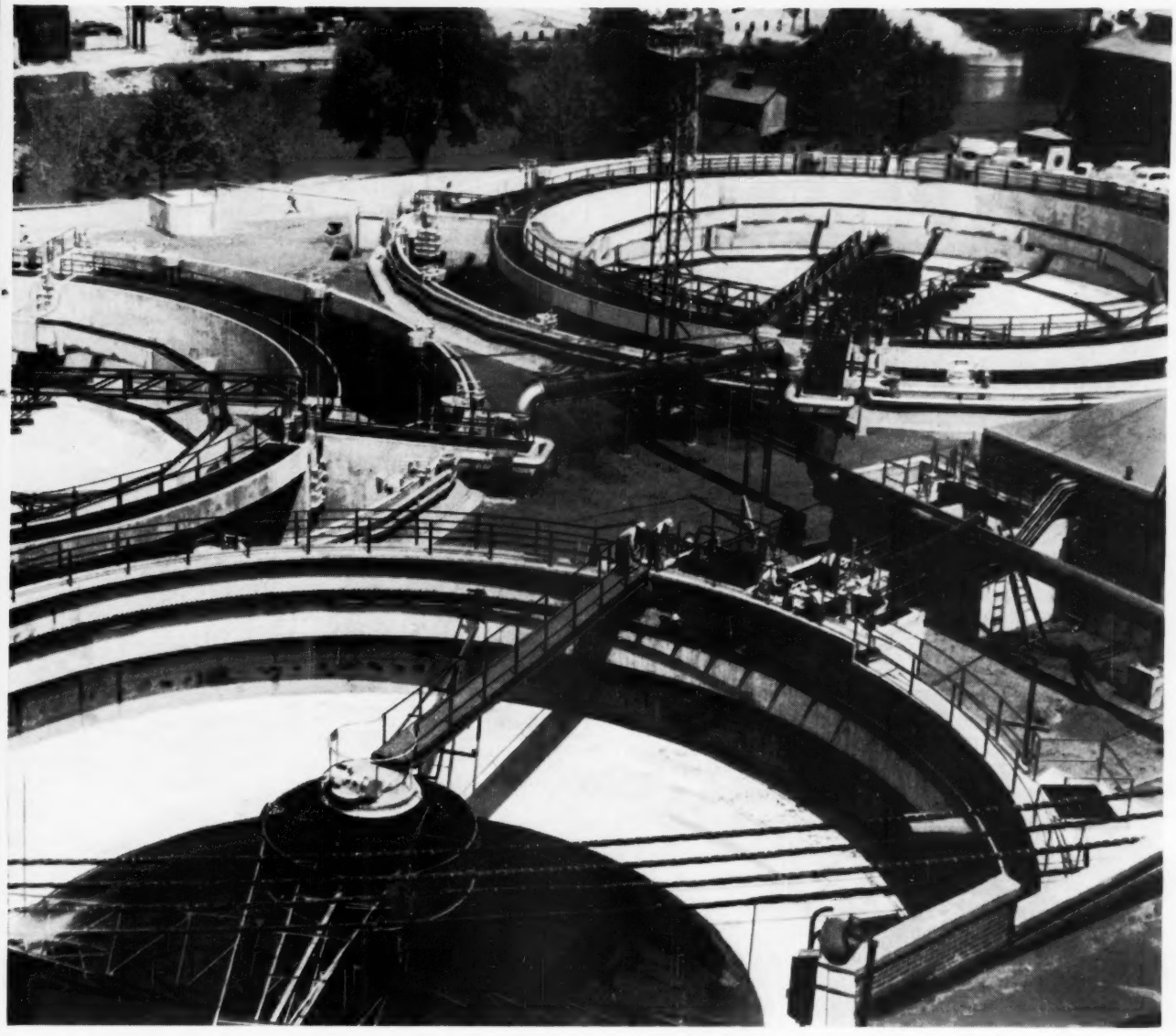
West Virginia Pulp and Paper Company Pioneers New Waste Treatment Process

Dorr-Oliver Equipped Plant Sets Pattern For Industry

Covington, Va. Industrial waste treatment has taken a major step forward with the start-up of this new plant at West Virginia Pulp and Paper Company's Covington, Va., mill. A "first" for the alkaline pulping industry, it points the way toward a solution of these tough-to-handle wastes. Two years of pilot plant work went into the final design and the Covington mill's River Research Group worked closely with the National Council for Stream Improvement throughout all phases of the project. The firm of Weston, Eckenfelder and Hood was also called in to make an intensive round-the-clock analysis of pilot plant results.

The flowsheet as developed is unique. Basically it employs the activated sludge process, one of the standard methods for treating municipal sewage. A departure from standard practice is the addition of certain nutrients essential to the life of the bacteria which carry out the treatment process. Another is split treatment providing primary sedimentation for the portion of mill wastes containing solids and then parallel aeration and final sedimentation for the entire flow. A third is the use of complete instrumentation with one control panel governing the process and recording results.

Average treatment plant design is 16 MGD with a maximum capacity of 25 MGD. Major



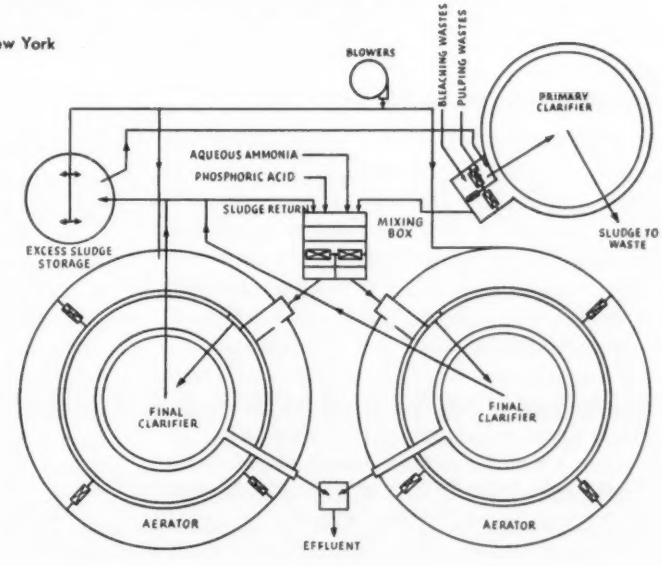
General view of the plant during final stages of construction. Dorr Primary Thickener is in foreground with Currie Claraetors in rear.

Consulting Engineers: GIBBS & HILL, INC., New York, New York

equipment units include a Dorr Primary Thickener and two Currie Claraetors.* These latter units employ Dorr Final Clarifiers surrounded by annular aeration channels. In this way two distinct phases are carried out in a single unit. When the plant reaches full operation an estimated BOD reduction of 80-90% will be made in the mill effluent being discharged to the Jackson River.

Dorr-Oliver Incorporated, Stamford, Conn.

*Trademark, Reg. U. S. Pat. Off.



from vacuum resids were: 40.6% gaseous hydrocarbons, (48.6% olefinic), 34.2% liquid products and 25.2% coke. The coke is electrode-grade.

By lowering reaction temperature, product distribution is shifted toward maximum liquid oil production. So Hoechst has a two-way process that could be very useful even in the U. S. where natural gas for making olefins is plentiful.

Nonelectrolytic peroxide for two

It's been kept very quiet, but for over a year Becco Chemical Div. of Food Machinery has been building a big hydrogen peroxide plant at Buffalo, N. Y., to utilize its new low-cost, nonelectrolytic process. And now the plant, which probably cost $2 million, is making tank cars of product.

Close on Becco's heels is Allied's Solvay Process Div., whose nonelectrolytic peroxide plant at Syracuse, N. Y., is just about completed and should be producing sometime this summer.

Neither company will talk about its process. But it's believed that both of them, like Du Pont at Memphis, Tenn., based their methods on the Pfleiderer anthraquinone process developed by I. G. Farben in Germany during World War II.

When word of Becco's interest first leaked out a couple of years ago, its process was described in the press like this: 2-ethyl anthraquinone is dissolved in an organic ester of phosphoric acid (e.g., tributyl or trioctyl) in the presence of activated alumina and reduced to the hydro derivative. Then oxygen is blown through, forming peroxide and the original 2-ethyl anthraquinone. Finally, peroxide is extracted with water and the quinone is recycled. Becco still won't confirm or deny this route, but it's an odds-on bet that it's essentially correct.

Nuclear eyes focus on Geneva

"After the Geneva atomic energy conference, you can scrap most of your ideas on nuclear engineering." That's the feeling here on the tremendous impact of this monumental conference set for Aug. 8-20 in Switzerland. For the mountain of hitherto classified nuclear technology that will be revealed will relegate your most advanced knowledge to the ranks of the fundamental.

Eighty nations—over 700 delegates—will meet to discuss scientific and technical ways and means to advance peaceful atomic uses. No politics! And indications are that the U. S. may find that other nations, particularly Russia, have not only kept up in the field but are surging ahead.

The U. S. is going all out to release as much technical data as possible. Individual Americans submitted 1,100 abstracts for AEC screening. These were culled to about 535—covering the gamut from reactor technology to isotopes, from mining to medicine—and submitted to the U. N. Russia sent in only about 100 abstracts, but from their titles it seems probable that the Soviets will at least match us in quality and significance of presentation. One Russian paper will undoubtedly discuss their first industrial atomic power plant (5,000 kw.), said to have started up last year.

All papers accepted by the U. N., every one original and unpublished, will be published later. However, only a percentage can actually be delivered at Geneva in the 12 days allotted.

Also of high interest are the technical exhibits planned, particularly the large research reactor being built there by the U. S. at a cost of $350,000. A pool type, this reactor will let scientists actually see how chain reactions are started, maintained and stopped. Qualified visitors will even be allowed to operate the device.

Paper probes better raw materials

One good way to get better products is to use better raw materials. And it looks like the paper industry is turning to that route. Two important research programs are under way at the Institute of Paper Chemistry at Appleton, Wis., one to breed better trees, the other to modify pulp from the trees we have.

Genetics is the key to the first. A natural polyploid tree (with extra sets of genes) differs from the normal diploids. Offspring of such strains might yield more fibers per acre. It's also known that colchicine (a plant hormone), higher temperatures and possibly radiation can produce artificial polyploids. The question the Institute hopes to answer is: Are they inheritable?

Genes controlling wood fiber characteristics like composition, density, disease resistance, penetrability, yield and quality will be checked, too. Hardwoods vary in the amount of α-cellulose, lignin and pentosans contained and the Institute believes that genetics can shift the composition pattern to a more optimum norm.

The second program deals with modifying cellulose molecules with additives. The Institute has already applied for a patent on a method for tacking 2% carboxymethyl cellulose on cellulose cotton linters molecules. In the lab this gave a

(Continued on page 110)

from "Royal Water" to Rocket Motors

Nitric Acid is as modern as tomorrow . . . yet ancient as alchemy. Today, its fuming forms have a vital role as oxidants for rocket propulsion. Yesterday, it was part of the ancients' gold-dissolving "royal water." And, across the breadth of present-day industry, it serves in a host of ways . . . in metals and metallurgy, engraving, explosives, nitrations, etc.

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pulp that could be beaten in one-sixth normal time and a paper with double the burst strength, 50% more tensile strength, 13 times better fold strength and a minor decrease in tear strength. Other possible additives are hydroxymethyl and hydroxyethyl cellulose, phosphoric acid and nitrogen dioxide, all for improving water affinity.

If the right processes are found, paper made from Douglas fir, which is plentiful in the Northwest, might be upgraded to near that made from scarce western hemlock. Likewise, southern pine might well compete with northern spruce.

Two reveal new polyethylene interest

You may well be getting tired of hearing about low-pressure polyethylene, but still, like Salk vaccine, it stays in the headlines. Latest is that both Monsanto and Du Pont will be making the high-density plastic by this fall.

Monsanto is putting in an interim plant at Texas City to make "a new high-density, boilable polyethylene" by a low-pressure process it's been pilot-planting at Dayton, Ohio, for several months. The company declines to identify the process, but does admit to licensing the Ziegler process.*

However, Monsanto says it's not at all sure that low-pressure processes will be best. And to cover all angles, the firm is running two modified-high-pressure pilot plants—at Texas City and Dayton—aimed at high-density polyethylene.

Du Pont, though, is definitely joining Koppers and Bakelite in production of Ziegler-polyethylene and is building a small unit at Orange, Tex. Like the others getting into this field, Du Pont wants maximum-density resins for increased stiffness and better high-temperature characteristics. Success would open up important new markets for polyethylene, such as rigid pipe and toys.

Needed: Way to cleanse atomic fuels

The Atomic Energy Commission wants chemical help. Several utilities want to run commercial atomic power plants, but so far nobody wants to operate a "chemical processing" plant.

Such a plant would process used fuel slugs for re-use. With a good process for removing fission products that poison the slugs a firm could have an "in" with just about every atomic power plant operator, since such processing expenses are a big part of present power cost estimates.

But the chemical industry is reluctant. To be economical such a plant would have to work with one standard shape of fuel element—and there's no such standard now. Also, there's some question as to the payoff for chemical companies. Utilities can afford to spend a lot on development because it costs them nothing—rate levels are set to give specific returns on investment, and development costs are deducted in establishing a rate base.

The argument on the other side is that a company coming up with a good process for purifying uranium fuel slugs will likely be able to adapt it to other uses. And potential profits would make the development worthwhile.

Speedup coming for patents

This month the Patent Office started hiring the technical personnel it needs to cut down the immense backlog of patent applications.

Such action is possible now because Congress, which for two years has heeded Eisenhower budget recommendations to keep the Office at or below past levels, this year voted it $2 million more than the administration requested. Big factor was a flood of complaints to Congressmen on the time it takes to get a patent—four years average.

Aim now is to hire 300 new examiner candidates. Once trained they can help pare down the present 225,000 backlog of applications. But even with the new personnel it will take 11 years to get down to an "ideal" 100,000, assuming no change—through mechanization—in the present disposal rate of 95 applications per man per year.

Congress was told that $14 million is the most the Office can profitably use this year since prospective examiners aren't plentiful. But since hiring will be gradual, full expenses won't be reached until July 1956. So Congress would have to allocate $15.2 billion for fiscal 1957. If another 150 examiners were hired then, the Office would need $17 million for fiscal 1958.

Though more examiners would hasten backlog cutting, the money needed might be a bitter pill for Congress. One sweetener would be to boost patent fees, which now cover only 45% of costs. Commerce Secretary Weeks has okayed a plan to cover 70–75%. But such an increase would hit primarily corporate inventors—the ones with long, complicated applications—which makes Congressional approval unlikely. In turn this makes hiring of more than the approved 300 examiners extremely doubtful.

For more of WHAT'S HAPPENING. 112

* For background on the various low-pressure polyethylene processes, see *Chem. Eng.* 1955: April, p. 103, June, p. 103, July, p. 104 and 144.

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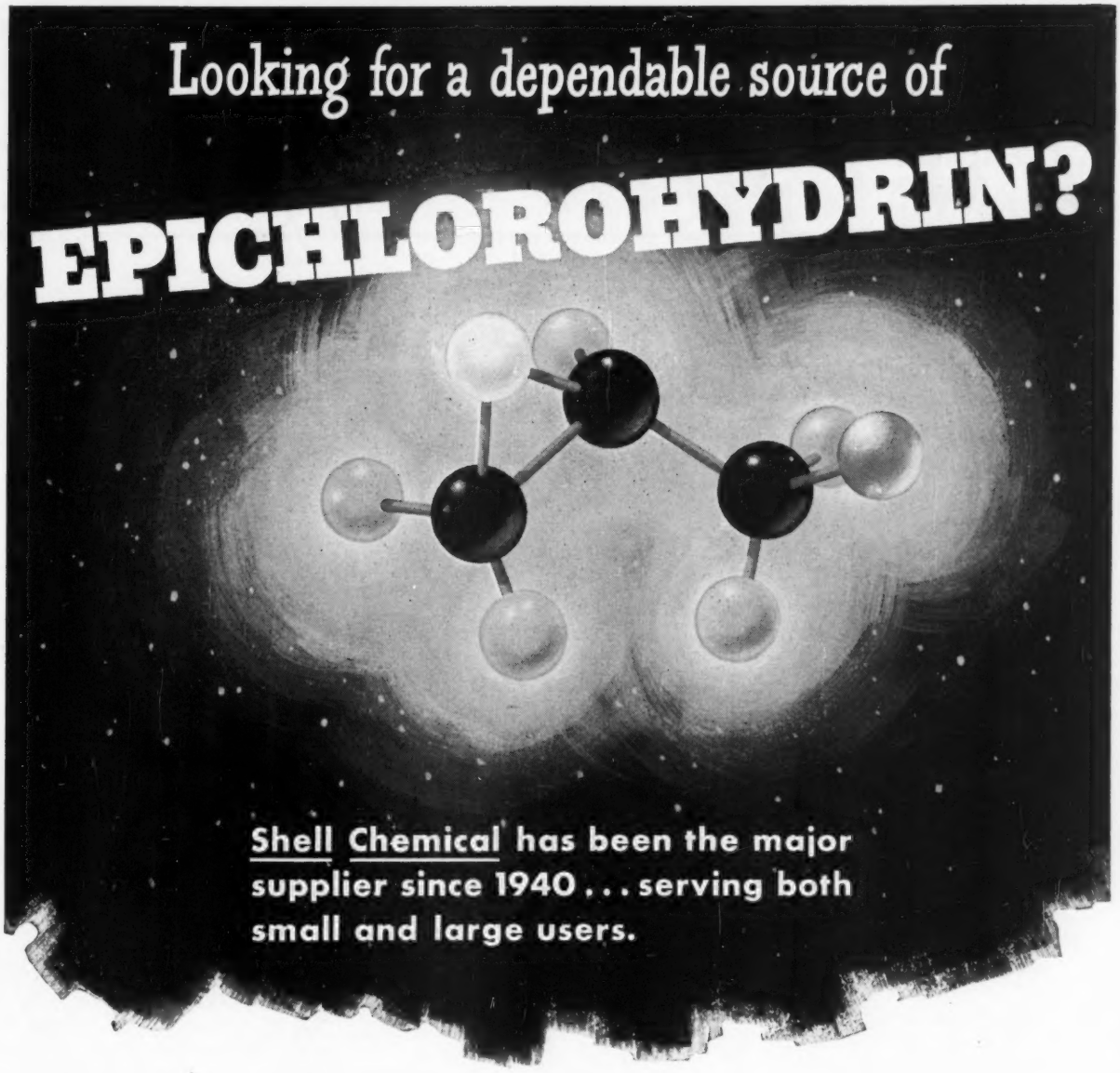

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AUGUST
1955

What's Happening

THIS MONTH'S

Feature News

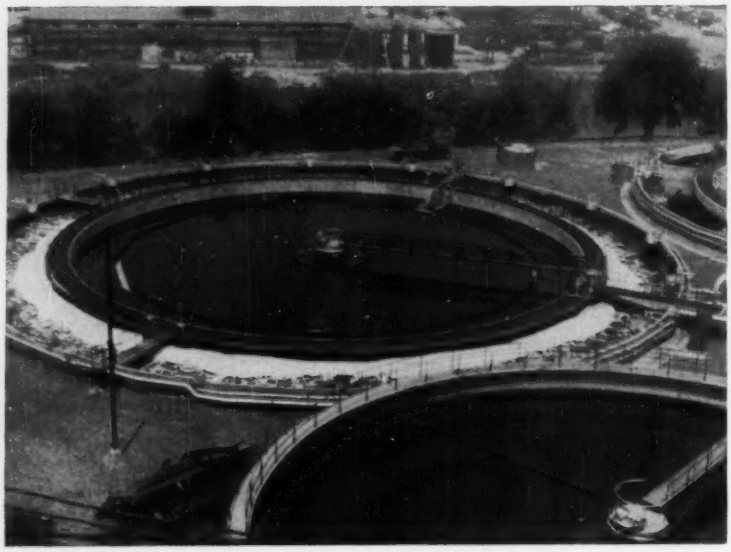
Bio-Oxidation of Wastes..... 112
Fractionation Tower Design.. 116
Convention Calendar 118
Synthetic Liquid Fuels..... 120
Direct Ammonium Sulfate... 124
Electronic Control System... 128
Nuclear Heat for Processes... 132
How Saran Film Is Made.... 134
Paper From Bagasse..... 136

Check This for Possible Tax Savings

Though you'll have to get a ruling from your local tax commissioner, the way your plant machinery is mounted may be costing you extra property taxes.

A recent survey by Barry Controls, Inc., of Watertown, Mass., shows that in many areas of the country a machine that is not lagged or bolted to the floor is taxed as personal property and therefore comes under accelerated depreciation provisions. But in some sections, machines that are lagged to the floor are considered part of the real estate and are taxed as such.

Barry, a producer of leveling mounts and shock and vibration isolation equipment, points out that when leveling mounts are used, book value of the equipment is lowered faster if accelerated depreciation is being applied. Since book value is usually the basis for assessment, reducing it cuts the amount you have to pay in property taxes.



BIO-OXIDATION OF PROCESS WASTES . . .

Gets a Foot in the Door

First activated sludge plant to treat pulp mill wastes begins operation at Covington, Va. Addition of phosphorus and nitrogen nurtures bacteria.

Latest treatment plant for process wastes using an activated sludge process—and the first in the pulp and paper industry—has just gone on stream at the Covington, Va., mill of the West Virginia Pulp and Paper Co.

Plant design is based on data collected in a pilot plant over a two-year period. The $2 million full-scale pollution abatement works has a rated capacity of 16 million gal./day and a maximum of 24 million. Layout considers the possibility of expanding the plant 50%.

Prime function of the new plant is to reduce biochemical oxygen demand (BOD) of pulp mill wastes from about 140 ppm. to 15 ppm. Key to the process was the discovery by W. A. Moggio of the paper industry's National Council for Stream Improvement that only nitrogen and phosphorus are needed in kraft mill wastes to provide a diet that is nutritious for activated sludge organisms.

These bacteria convert organic process wastes into products that have a low BOD.

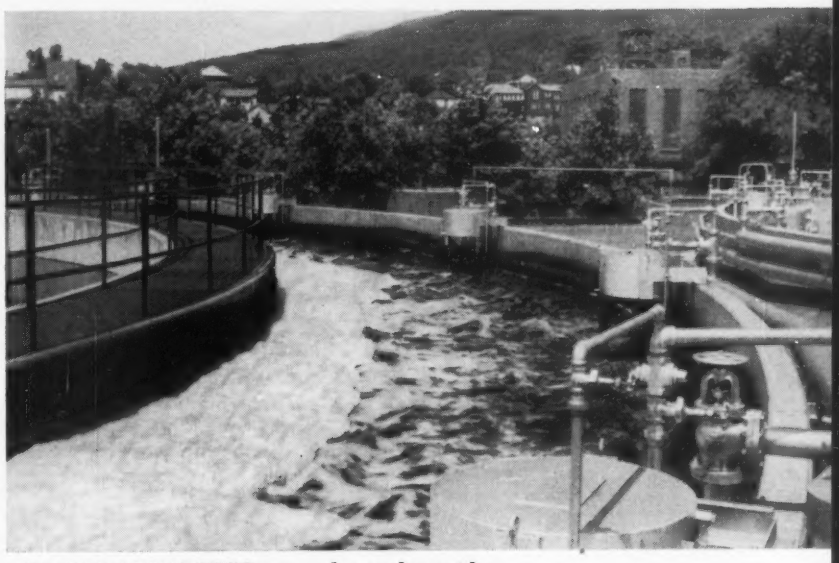
►**Unusual Goal**—With the waste

in Chemical Engineering

treatment plant at Covington now in operation, West Virginia Pulp and Paper management has set an unusual goal. Instead of production in tons of paper, it is in terms of fish and where they'll swim.

The Jackson River, a picturesque mountain stream, splits the Covington mill site. About 20 miles downstream it joins the larger James River on a 300-river-mile jaunt to Richmond and then on to the Atlantic.

Shortly after World War II, the company management adopted a voluntary pollution abatement program at Covington. By in-plant process improvements alone since then, fish have moved 20 miles back up the James River. Eventual goal: right up into the Jackson River to the plant sewer discharge pipe.



AERATION CHAMBERS surround secondary settler.

▶ **Flow Varies**—With no industrial users upstream, the Covington mill counts on the Jackson for its supply of fresh process water. But the Jackson is fickle.

During the spring flood season its daily flow may be 10,000 million gal. But in late summer, daily flow may fall to 40 million gal. The mill needs 30 million gal. of fresh water every day of the year and returns 24 million from its sewers (6 million gal./day are incidental and evaporation losses).

Therefore it is possible that during drought periods, the flow of the Jackson River below Covington may be made up almost entirely of paper mill effluent.

▶ **High BOD Wastes**—The sewer discharge emanates from processing, washing and bleaching the pulp. These various wastes—mostly complex organic compounds such as lignin, lignone, cyclohexenedione, carbohydrates and resins, along with plant washdowns and domestic sewage—produce an effluent with a moderately high biochemical oxygen demand (BOD). This can be measured in terms of the equivalent BOD produced by domestic sewage from a certain number of persons—the population equivalent.

(For a breakdown of the mill wastes and their human population equivalent see table on the next page.)

▶ **pH Not a Problem**—Initial operation of the pollution abatement plant indicates that the control of pH will not be a major problem.

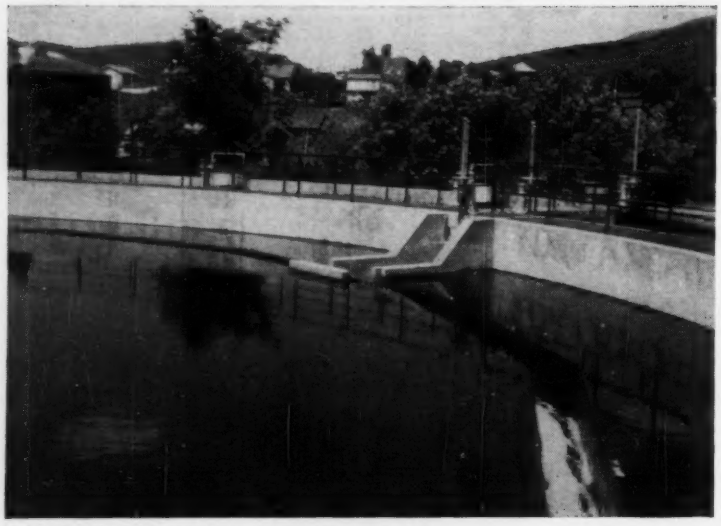
Although the pH of the incoming waste streams varies from 2 to 12, the activated sludge settling tanks have been holding consistently between 7.3 and 7.4.

Therefore, the major tasks for the new plant will be to lower solids content, reduce biochemical oxygen demand and avoid foamy or colored sewer discharges.

▶ **Five-Step Process**—To reduce BOD and solids content of the wastes, West Virginia adopted a five-step process developed in a two-year pilot-plant program under the direction of H. E. Miller, technical director, and his assistant, J. M. Kniskern. The process steps are:

- Primary settling to reduce solids content.
- Addition to primary effluent of 75% phosphoric acid to give 2 ppm. of phosphorus and of 35% aqua ammonia to give 4 ppm. of nitrogen.
- Aeration of a mixture of waste liquor and activated sludge.
- Sedimentation of activated sludge from its associated treated liquor.
- Return of most of the settled sludge organisms to be mixed with incoming raw wastes.

▶ **Process Equipment**—Large lines bring mill wastes to the primary



DOUBLE-WEIR overflow ups settling capacity.

Waste Water Balances at Covington

From	Volume, Million Gal./Day	Human Population Equivalent†
Pulping operation		
Screen room	1.5	40,000
Semichemical backwater overflow	2.5	
Chemical recovery plant	2.5	30,000
Byproducts plant (tall oil, activated carbon)	1.5	15,000
Bleach room, chlorination and caustic stages	8.0	40,000
Totals	16.0*	125,000

* Remaining 8.0 million gal./day is low in pollution and after some preliminary filtering of the paper-machine backwaters will continue to flow directly into the river.

† Based on 0.167 lb. of BOD/person-day.

settler control box that feeds them to the 100-ft.-dia. primary settling tank. Retention time is two hours. Sediment, along with net sludge production, is pumped to the mill's flyash lagoon and held until such time that the river flow will allow emptying.

After nutrient and sludge addition, the liquor flows to the outer aeration sections of two 175-ft.-dia. combination aerator-clarifiers (based on the Dorrco-Currie design). The 120-ft.-dia. final clarifiers are surrounded by annular-shaped aeration chambers.

The annulus is 25 ft. wide and subdivided into four quadrants for operating flexibility. (See photos on preceding pages.)

In each aeration compartment are four impingement-type aerators designed to supply 1 cu. ft. of air/gal. of waste. These diffusers are installed on the outer periphery and operate with no moving parts. Compressed air supply is from four axial-flow positive-displacement blowers rated at a total capacity of 14,000 scfm. at 8 psi.

Final clarifiers have sludge collecting mechanisms by which controlled quantities of excess activated sludge are withdrawn to storage for recovery and reuse. Here it is held for 24 hours since the sludge itself has some BOD and cannot be discharged directly to the river. Final clarifier effluent overflows to the sewer discharge diffusing pipe.

▶ **Plant Startup**—Official starting date for the plant was May 23. According to Hugh R. Sumner, pollution abatement engineer, it was a very relaxed startup.

Around-the-clock coverage by technical personnel was not required. The operator on each shift was in control of the situation and found no need to call for technical assistance.

Sumner attributes this mostly to good pilot plant data, careful design by Gibbs and Hill, Inc., and full-time coordination of construction work by West Virginia's own engineering staff.

Rated capacity of the treatment plant is 11,200 gpm. Starting rate was 1,000 gpm. To initiate bacterial action, sludge from the Roanoke, Va., municipal treatment plant was trucked in and added to the activated sludge tanks to produce about 800 ppm. in the aerators.

As nutrients were added, the organisms began to multiply and plant throughput was stepped up in 600-gpm. increments. By June 2, at the time CE's editor visited the plant, operating load was 4,000 gpm. with no apparent difficulty. By July 1, it was expected that the plant would be up to full capacity.

▶ **Automatic Control**—Extensive automatic metering and testing equipment is installed along the process flows. Readings are registered in the central control house. Continuous recordings are made of pH, temperature, electrical conductivity and flow rate.

Only one operator per shift is needed to keep the plant on an even keel.

Every morning, to check on the effectiveness of the operation, a pollution abatement testing team takes samples about 20 to 30 miles downstream to test BOD. First tests indicate that the new waste treatment plant is living up to design expectations.

And to take care of those occasional spillovers that will happen every so often, the Covington mill has added one other piece of equipment. Whenever a particularly foamy or discolored slug appears in the plant sewer lines, you can see the pollution team's motor scooter on its way down the road to catch a sewer sample that will help pin down the cause.

Management policy is that once the treatment plant is operating at full capacity, any spillovers will be the direct responsibility of the offending operating area. If necessary, production will have to shut down until the situation is corrected.

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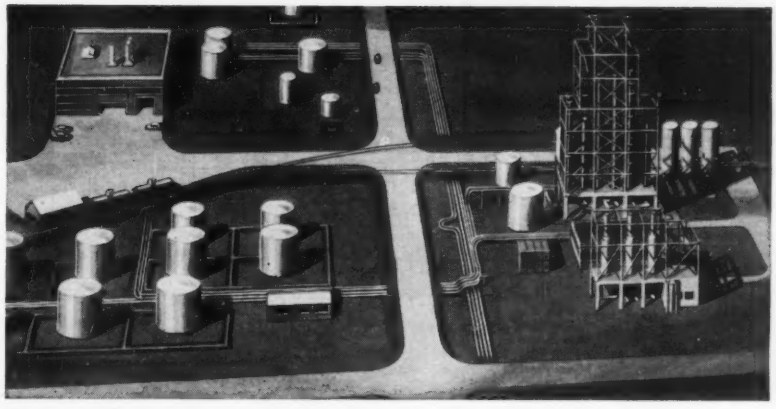
LUMMUS TO BUILD AIR REDUCTION CHEMICAL'S VINYL ACETATE PLANT AT CALVERT CITY, KENTUCKY

Lummus-Built Plant To Come On Stream In Early 1956

The 30,000,000 lb. per year vinyl acetate plant which The Lummus Company is engineering and constructing for Air Reduction Chemical Company, a division of Air Reduction Company, Inc., is a good example of how industry can set up an integrated plant in a strategic location, and insure maximum returns for its capital investment. The plant's attractive location at Calvert City, Kentucky has all the benefits of readily available power, natural gas, water transportation, and a host of related chemical products.

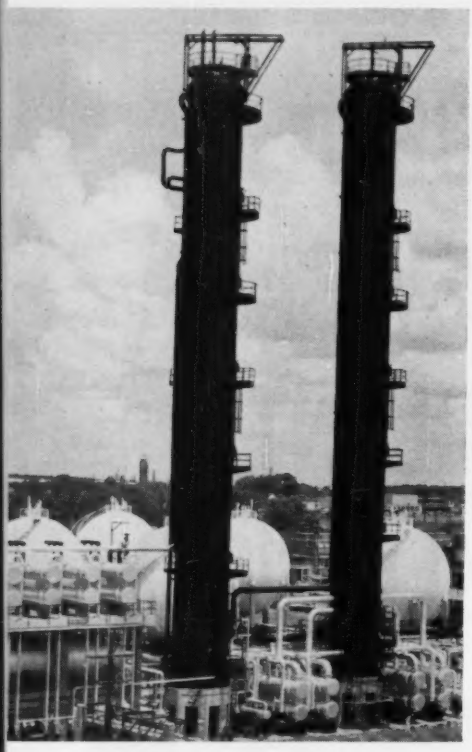
This $3,000,000 installation scheduled for completion early in 1956, is adjacent to the calcium carbide and acetylene plant of Air Reduction's National Carbide Division, and will receive pipeline acetylene from it. The new vinyl acetate plant will be a key development in Air Reduction's chemical expansion which begins with basic raw materials and ends with a variety of products having important commercial and industrial uses.



Vinyl acetate goes principally into polyvinyl acetate emulsions, used in adhesives, latex paints and textile finishes, and polyvinyl alcohol used for adhesives and textile finishes.

At Calvert City, in addition to this new Air Reduction plant, Lummus is also building a $6,000,000 high pressure acetylene derivatives plant for General Aniline & Film Corporation. What better example could be given to show that Lummus is ready, willing and able to design, engineer and construct your next chemical plant.

The Lummus Company, 385 Madison Avenue, New York 17, N. Y. **Engineering & Sales Offices:** New York, Houston, Montreal, London, Paris, The Hague, Bombay. **Sales Offices:** Chicago, Caracas. **Heat Exchanger Plant:** Honesdale, Pa. **Fabricated Piping Plant:** East Chicago, Indiana.



Efficiency Data, 13-Ft.-Dia. Extractive Distillation Tower

Trays	Murphree Efficiency, % Isobutane Butylene-1	n-Butane Butylene-1
10–17	25	24
17–22	21	22
22–28	20	20
28–33	19	20
33–38	19	20
38–43	21	20
43–51	21	—
51–56	21	—
56–59	33	—
59–62	44	—
62–64	40	—
64–67	40	—
67–72	35	—
72–78	25	27
78–83	—	27
83–95	—	33
95–97	—	30
Average	25	25
Predicted	29	32

Practical Proof of Lab Data

Overdesign of butylene fractionation tower was avoided by accurate prediction of plant performance from laboratory tests on a different system.

Complete operating data recently obtained on the two distillation towers shown above check remarkably well with performance predictions based on laboratory tests with entirely different materials.

These 13-ft.-dia., 50-tray towers—which actually operate as a single 100-tray tower, split to keep overall height within bounds—were installed two years ago by Neches Butane Products Co., Port Neches, Tex., to fractionate a mixture of butanes and butylenes by extractive distillation with furfural. Design was based on laboratory tests run at University of Delaware on the desorption of oxygen from oxygen-rich water with air.

Measured plate efficiencies on the plant towers range from 19 to 44% (see table), compared with predicted efficiencies of 25 to 35%.

► **Unfavorable Conditions**—Extractive distillation with furfural, from the standpoint of tray efficiency, leaves much to be desired. Here's why:

- Vapor flow rate is low compared with liquid flow rate; thus interfacial area is low.
- High liquid rate and short liquid path to (avoid excessive hydraulic gradients) mean relatively low time of contact between liquid and vapor.
- Liquid properties are unfavorable (viscosity is three times that of gasoline).

These conditions add up to low mass-transfer rate in the liquid phase and poor tray efficiencies.

► **Extravagance Taboo**—In some problems where the designer is faced with a low-efficiency system, e.g., gasoline absorbers, total tray requirements are small enough to allow a generous safety factor on tray efficiency. But too much investment was at stake in the Neches job to tolerate extravagant overdesign.

Office of Synthetic Rubber (government agency responsible for plant operation at that time) therefore retained University of Delaware chemical engineers to work out optimum tray design and run sufficient tests to predict tray efficiencies under plant operating conditions.

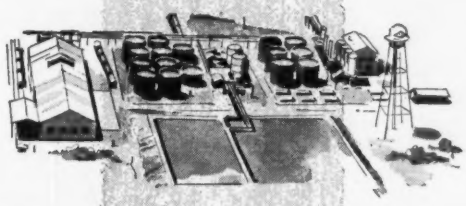
► **Tray Design**—Problem was to get as good vapor distribution as possible in spite of high liquid loading and low vapor throughput. Tunnel caps parallel to the direction of liquid flow were shown to be superior to any other type of bubble cap for minimizing hydraulic gradient.

Hydraulic gradient is minimized also by using a comparatively short path of liquid travel. The plant towers use a double split-flow system—the liquid entering each tray is split into four separate streams in flowing across the tray. The distance from inlet to outlet for any one stream is only 23 in. in a 13-ft.-dia. tower.

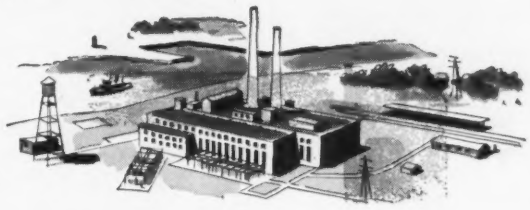
Caps are 4 in. high, 2½ in. wide and 20 in. long. Slots are 1 in. high on ½-in. spacing. Slot width is $\frac{5}{16}$ in. at bottom, $\frac{3}{16}$ in. at top. Outlet weir height is 2½ in. Distance between adjacent cap faces is fairly wide—4 in.—to maximize liquid residence time on the tray. Lab tests showed good vapor-liquid contact even with this wide spacing.*

► **From Lab to Plant**—Laboratory work used a portion of a full-scale tray of this design to test efficiency on the desorption of oxygen from water with air. This system resembles the extractive distillation oper-

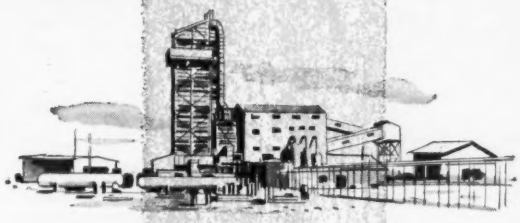
* Present management of Neches Butane Products, now a privately owned company, declines to release a tray diagram for publication.



PETRO-CHEMICAL PLANT in Texas to produce ethylene from natural gas by the owner's process.



GENERATING PLANT, one of three of 66,000 KW each, installed for electric utility company in Southwest.



ORGANIC CHEMICAL PLANT to produce insecticides—DDT and BHC—located in the State of Alabama.

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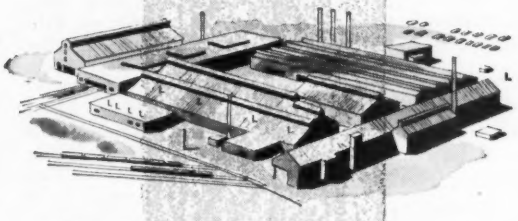
PAPER MILL in the South's pine belt, increasing its capacity by nearly 500 tons of newsprint daily.



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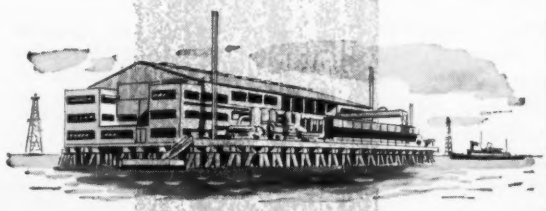

PRESSURE MAINTENANCE plant for Venezuelan gas reservoir built in 62 ft. of water with 50,000 h.p.

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ation in only one regard—mass transfer in the liquid phase is controlling.

Test conditons used the same volumetric gas rate, liquid rate, weir height and cap design as the projected plant operation. Uncontrolled variables were degree of mixing, gas and liquid holdup, and amount of entrainment.

Liquid path in the lab setup was 32 in., appreciably longer than in the proposed tower design. Lab efficiency data were corrected to disallow the extra mass transfer which would not be obtained on full scale. This correction amounted to about 6% (i.e., uncorrected efficiencies averaged 36%).

▶ **Operating Conditions**—Liquid flow rate in the plant towers is 65-85 gpm. per ft. of weir length. Vapor rate is 0.6-1.0 ft. per sec. Furfural concentration in the liquid is high—91 mole % furural-water at the top, 81 at the bottom. Depth of liquid on trays is 4.0-4.2 in.

The butanes-butylenes feed enters below the 50th tray, or at the top of the "lower" tower. Furfural-water enters on the fifth tray from the top of the "upper" tower and leaves with the butylene bottoms. Main separation is between isobutane and butylene-1. (A separate stripper recovers the solvent from the bottoms.)

Operating pressure is 86 psi. at the top and 98.5 at the bottom. Temperatures are 112 F. at top and 292 F. at bottom.

The new towers replaced an older 13-ft.-dia. installation which used large, closely spaced, round caps and single split liquid flow. Improved tray design in the new towers has permitted a boost in feed rate from 4,300 to 6,720 bbl. per day.

Microballoon Expansion Slated by Colton

Microballoons are definitely moving out of the pilot-plant class. Colton Co., a division of Air Reduction Co. of New York, plans to build a $500,000 plant in Cleveland to turn out 5 million lb./yr. of its urea-formaldehyde version of the spheres. (Bakelite also makes microballoons, but from phenol-formaldehyde resins; Colton found the U-F ones lighter, more water-resistant and less expensive.)

Since this product was introduced commercially two years ago as a way to cut evaporation losses of crude oil, there's been no overwhelming rush by the oil industry to buy in quantity (it takes about 4,000 lb. to serve a 120-ft.-diameter tank). But several big companies are testing them and indications are they like what they find.

Standard Oil of Ohio developed the idea originally and is using large quantities of the balloons for its own crude oil tanks. They've found about a 90% drop in crude oil storage losses. On lighter fractions, such as gasoline, the reduction is closer to 60%.

Three Titanium Plans Get Government Okay

There's certainly no letup in the search to find new ways to produce titanium metal. Latest in the parade are three new research and development agreements between the government and private firms:

• First came a contract between the Bureau of Mines and Wah Chang Corp., New York, to study the company's improved process for making sponge titanium by magnesium reduction of the tetrachloride. Work will be done at the Bureau's Boulder City, Nev., station. Wah Chang, a major producer of tungsten, will bear most of the cost.

• Next to be revealed was receipt of a contract by National Research Corp. of Cambridge, Mass., for nearly $1.2 million from the General Services Administration. GSA will finance a 1,000 lb./day pilot plant at Newton, Mass., which will use a new fused salt process for making titanium.

• Finally, GSA has agreed to pay $95,600 to Horizons, Inc., of Cleveland for experimental work on a process to regenerate titanium from impure scrap metal.

Convention Calendar

National Industrial Conference Board and Stanford Research Institute, symposium on Electronics and Automatic Production, Sheraton-Palace, San Francisco, Aug. 22-23.

American Soybean Assn. and National Soybean Processors Assn., joint annual meeting, Netherland Plaza Hotel, Cincinnati, Aug. 29-31.

Production Engineering Show, Navy Pier, Chicago, Sept. 6-17.

American Institute of Electrical Engineers, second "Electrical Conference of the Petroleum Industry," Shamrock Hotel, Houston, Sept. 12-14.

Instrument Society of America, 10th annual conference and exhibit, "Instrumentation Paces Automation," Shrine Exposition Hall and Auditorium, Los Angeles, Sept. 12-16.

Chemical Institute of Canada, corrosion symposium, Sheraton-Mount Royal Hotel, Montreal, Sept. 15-16.

Society of Industrial Packaging and Materials Handling Engineers, 10th annual Packaging and Handling Exposition, Kingsbridge Armory, New York City, Sept. 20-22.

Chemical Market Research Assn., "Management Looks at Consumer Products," The Cavalier, Virginia Beach, Va., Sept. 22-23.

American Assn. of Textile Chemists and Colorists, annual Textile Dyeing and Finishing Exhibition, Chalfonte-Haddon Hall, Atlantic City, N. J., Sept. 22-24.

Drug Chemical and Allied Trades Section of New York Board of Trade, 65th annual meeting, Pocono Manor Inn, Pocono Manor, Pa. Sept. 22-25.

American Institute of Chemical Engineers, featuring "Atoms for Profit" and "Growth of the Oil and Chemical Industry by Integration," Lake Placid Club, Lake Placid, N. Y., Sept. 25-28.

Atomic Industrial Forum, First Trade Fair of the Atomic Industry, Sheraton-Park Hotel, Washington, D. C., Sept. 26-30.

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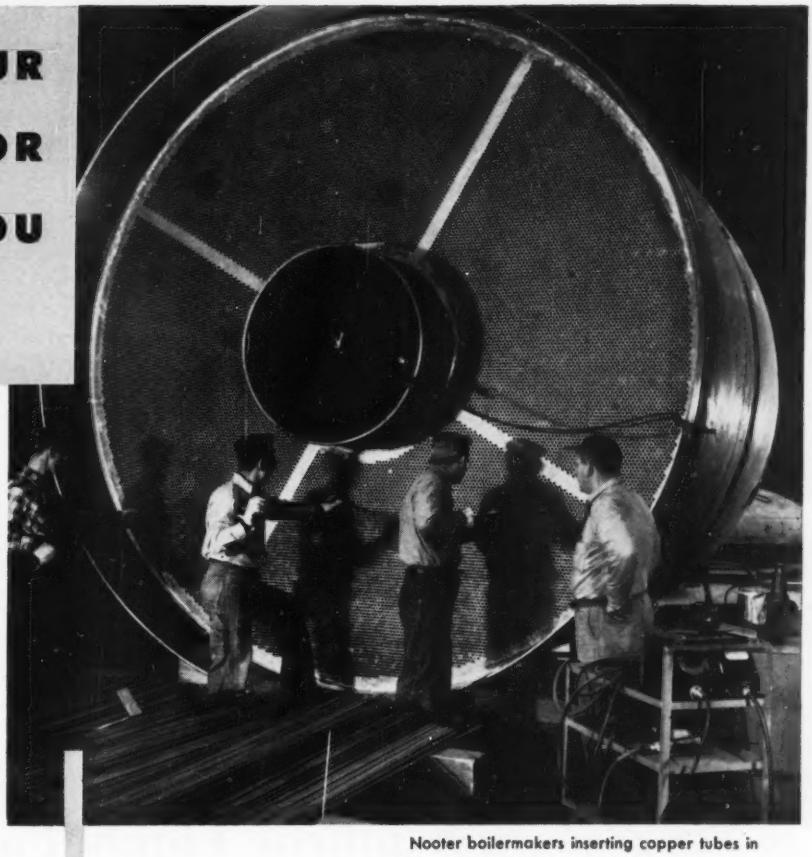

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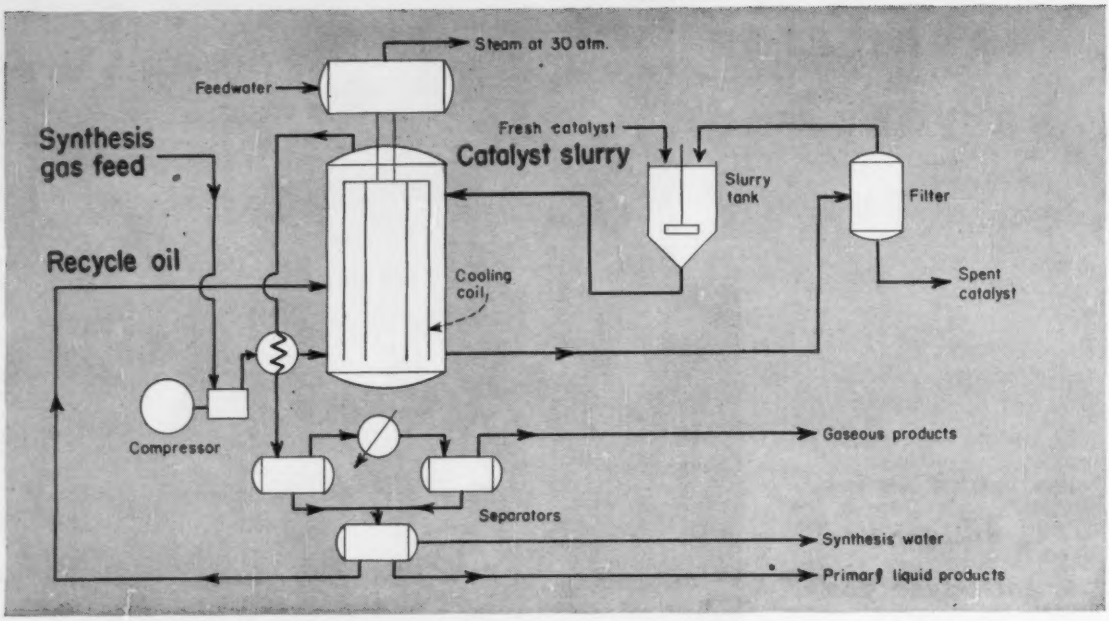

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Progress in Synthetic Liquid Fuels

Fischer-Tropsch reaction with catalyst suspended in oil promises high once-through conversion, wide flexibility in synthesis gas composition.

Prospects for more economical synthesis of liquid fuels via the Fischer-Tropsch route appear brighter today, as the result of recent semi-commercial-scale work done in Germany by engineers of Rheinpreussen A. G.*

Basing its investigation on the principle that maximum conversion of synthesis gas is the key to low-cost synthetic fuels, Rheinpreussen claims two-stage, once-through conversions as high as 97%. And the content of "useful products"—defined as C_5 and up—is 92 to 98% of the total synthesis products. Moreover, the process can use the cheapest synthesis gas composition available from coal gasification—a CO:H_2 ratio of 1:1.

▶ **American Support**—Koppers Co., Pittsburgh, has participated financially in the demonstration-plant work. Its representatives also have witnessed and studied the operation of the Rheinpreussen unit at Homberg (Lower Rhine).

Using Rheinpreussen data, plus its own experience and studies, Koppers offers to design commercial hydrocarbon synthesis plants. The company has an exclusive licensing arrangement with Rheinpreussen for the entire Western Hemisphere and certain other countries in Asia and elsewhere. This agreement covers the reaction of hydrogen and carbon monoxide to produce hydrocarbons and oxygenated compounds (such as alcohols, aldehydes and ketones).

Under present circumstances, Koppers admits, the process is not competitive in the U. S. However, these same circumstances don't necessarily apply outside the U. S., especially in countries not having petroleum deposits.

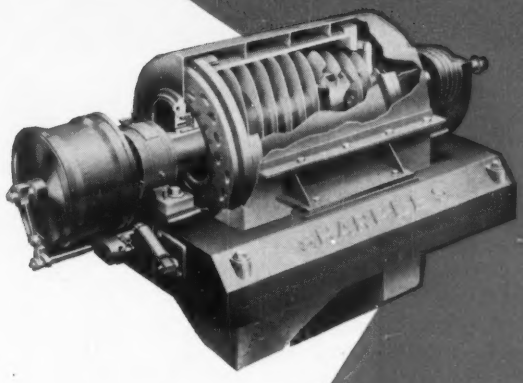
▶ **Three-Phase System**—Rheinpreussen's reaction system involves gas, liquid and solid phases. Compressed CO and hydrogen are dispersed in a liquid hydrocarbon in which the finely divided, precipitated-iron catalyst is suspended. Mass transfer through the gas bubbles into liquid solution and through the liquid to the catalyst surface does not limit reaction velocity, nor does solubility of the reactants in the oil, according to experimental evidence.

Cooling is provided by evaporation of water within coils immersed in the liquid. Heat exchange is said to be rapid. According to Rheinpreussen, "Heat-transfer figures obtained for the liquid hydrocarbon medium interspersed with rising gas bubbles were not much lower than those of evaporating water at a low rate of flow." Surface required is less than 15 sq. ft. per 1,000 cu. ft. of synthesis gas converted per hr.

One of the chief deficiencies of

* Reported at the World Petroleum Congress at Rome in June.

Add the Force of An Extra 1200 g's—...then Take a New Look at Your Slurries



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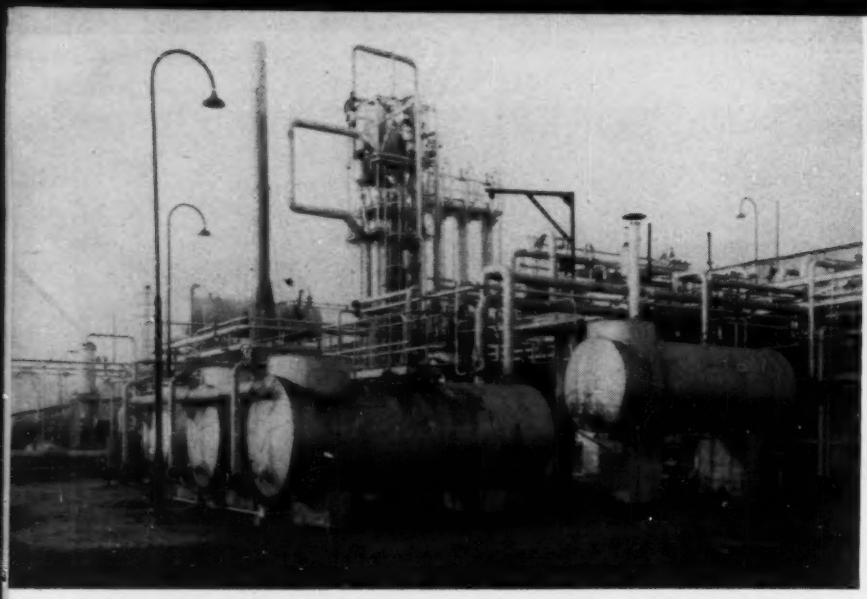


DEMONSTRATION PLANT can turn out 10 tons per day of synthetic fuels.

dry Fischer-Tropsch systems—either fixed or fluidized bed—is that they can't handle feed gases of optimum composition for once-through conversion. They depend on gas compositions relatively rich in hydrogen to avoid carbon deposition and catalyst deterioration; recycling of unconverted hydrogen is necessary. In contrast, synthesis in a liquid medium dispenses with the bother and expense of gas recycling, as the catalyst will process CO-rich gas without any disturbing carbon deposits.

▶ **Related Work Here**—American engineers have favored the fluidized-bed technique in a gas-solid system as the way to overcome heat-transfer problems associated with the original German Fischer-Tropsch plants using fixed beds. And with hydrogen-rich synthesis gas made from natural gas, carbon deposition is a minor problem.

Foremost in this work have been Hydrocarbon Research and M. W. Kellogg Co. Hydrocarbon Research designed the Carthage Hydrocol (now known as Hidalgo Chemical) synthesis plant at Brownsville, Tex., which uses natural gas as starting material. The plant has yet to achieve successful commercial operation.

Kellogg has designed the Sasol coal-based plant in South Africa, which is in partial operation. Sasol will use both fixed-bed and fluidized-bed reactors. The fixed-bed reactors work on hydrogen-lean synthesis gas, followed by a fluidized-bed system handling hydrogen-rich tail gas from the fixed-bed system.

Anticipating that even in the U. S. coal would be the ultimate Fischer-Tropsch raw material, the Bureau of Mines is studying the oil-slurry system. It has in operation at Bruceton, Pa., a pilot plant with a capacity of 3 gal. per day of product. Reactor is 3 in. dia. and 10 ft. high.

In contrast to the more expensive precipitated-iron catalyst used by Rheinpreussen, the Bureau has concentrated on cheaper catalysts, such as promoted iron oxides made from low-cost magnetite ores or mill scale.

▶ **Operating Data**—Rheinpreussen's semicommercial operations have been on a sizable scale. Useful reactor volume is 10,000 liters (350 cu. ft.), and catalyst charge is 880 kg. (400 lb.). For one particular set of conditions, space-time yield of C_5+ products was 930 kg. per 24 hr. per cu. meter of reactor volume. Converted to English units, this figures out to be about 10 tons per day of product.

Conditions for the yield just cited were as follows:

Pressure: 12 atm.
Temperature: 268 C.
$CO:H_2$ ratio: 1.5
CO conversion: 91%
CO + H_2 conversion: 89%

Ultimate performance may be even better. Rheinpreussen claims that by running at higher temperatures, say 280 C., space-time yields of more than 3,000 kg. per day per cu. meter (vs. 930 reported above) are obtained.

More Work Needed On Catalytic Muffler

Even though the Houdry catalytic converter for car exhausts removes more than 80% of hydrocarbon emissions initially, it appears to wear out too soon. That's the conclusion of the Air Pollution Foundation, based on comprehensive tests by Southwest Research Institute at San Antonio, Tex.

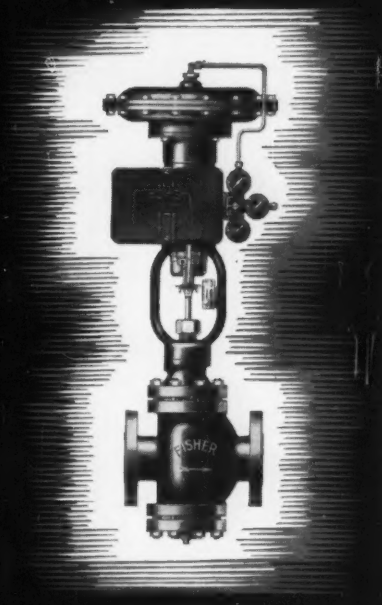
The inventor, Eugene Houdry, president of Oxy-Catalyst, Inc., Wayne, Pa., is confident that the present weakness of the device can be corrected in a short time. For now, though, W. L. Faith, vice president of the Foundation says: "It is apparent that further development by the manufacturer will be required before the muffler can be recommended as a likely solution for the Los Angeles automobile exhaust problem."

Plant Gets Sulfur From Low-Grade Ore

American Sulphur & Refining Co. of Beverly Hills, Calif., has started up its $1.1 million, 100-ton-per-day refinery at Sulphurdale, Utah (*Chem. Eng.*, March 1955, p. 101). Output is 99.7% pure crystalline sulfur for insecticides, soil sulfur for fertilizers and granular sulfur for rubber. The ore being processed averages only 20% elemental sulfur.

AS&R is using a solvent recovery process based on a patent owned by Esso Research and Engineering Co. (U. S. 2,195,870). The special solvent, which the company doesn't identify, is extracted from petroleum. At about 200 F. it takes up free sulfur; but when the temperature is lowered to 70-80 F., most of the sulfur precipitates.

The company believes that its process will be applied to many low-grade sulfur bodies in the western part of the United States and that it can compete economically with sulfur produced from salt domes by the Frasch process. In its own deposits, AS&R now has 3.9 million tons of proved ore with a total sulfur content of over 730,000 long tons.



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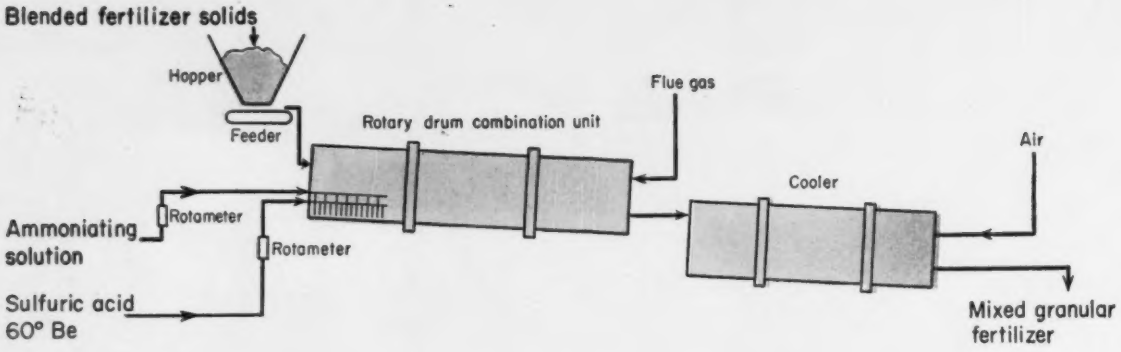


Heat of Reaction Cuts Processing Costs

By capturing the heat developed by reacting sulfuric acid added with ammonia, this compact new plant produces mixed, granular fertilizers cheaply and easily.

With competition getting keener every day, mixed fertilizer producers are ever on the lookout for new cost-cutting process improvements.

One of the latest of these developments, in ammoniation-granulation processing, is getting a lot of attention. It involves reacting added sulfuric acid with excess ammonia in the normal mixing operation. The heat of formation of ammonium sulfate is used to simultaneously drive off moisture from the mix.

This technique has been very neatly reduced to practice in a new continuous granulation plant, just recently starting operations in Ottumwa, Iowa.

Designed and engineered by Fertilizer Engineering & Equipment Co. of Green Bay, Wis., for Super-Crop Plant Foods, the installation turns out 10 tons per hr. of mixed, ammoniated, granular fertilizers. These operations are all done in a single rotary drum—including the formation of ammonium sulfate (see cut above).

The type of mixed fertilizer produced by ammoniation-granulation has many advantages over older types, but there is one objection raised by the consuming farmer: high cost. More involved processing usually makes it more expensive than the simple blended powders. The Super-Crop people consider two distinguishing features at Ottumwa as important factors in reducing these processing costs:

• By reacting sulfuric acid with excess ammonia, sufficient heat is developed to remove some moisture from the mix. Actually, this heat is a process bonus. The cost of raw materials for forming ammonium sulfate—an important nitrogen-sulfur carrier and fertilizer conditioner—directly in the mix is about the same as the cost involved in buying solid ammonium sulfate from coke-oven sources.

Usual practice in making granular fertilizers is to add an ammoniating solution to the solid components (superphosphate, muriate of potash and ammonium sulfate). There is a reaction between ammonia and superphosphate (also between a small amount of acid contained in the phosphate), but the quantity of heat given off is small.

• The plant is compact. Sulfate formation, ammoniation, granulation and drying all take place successively in one unit—a 5½-ft.-dia., 36-ft. long rotating drum. Here again, usual practice is to handle these steps in separate units.

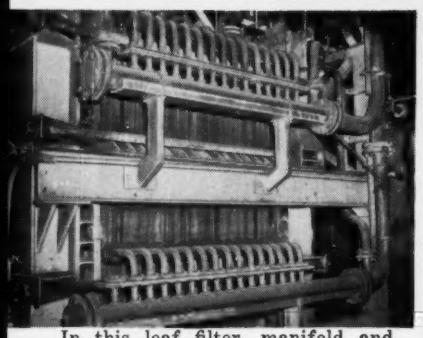
Actually, the technique of direct formation of ammonium sulfate in the mix is only part of the larger picture at Ottumwa. The Super-Crop plant fits nicely into three other important, but better established trends in mixed fertilizer processing.

First, a variety of high-nitrogen mixtures are produced*—they are becoming very popular for increasing crop yields, particularly in the Midwest. Secondly, dissolved nitrogen is added as a solution (ammonia and ammonia derivatives) to the solid components. This allows for the use of a cheap form of nitrogen. Thirdly, the finished mixture is in agglomerate, or granular form. This gets away from the troublesome caking, dusting and segregation problems that come up when applying powder-type mixtures to the soil.

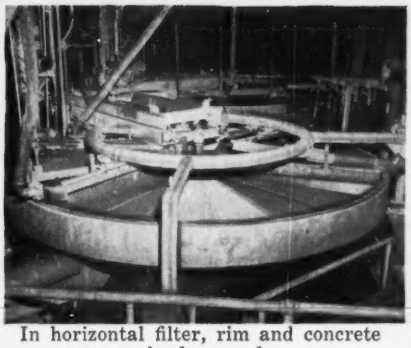
▶ **Making Mixed Fertilizers**—The combination unit is supplied with a mixture of blended solids—usually superphosphate and potash—from a gravimetric feeder. Sulfuric acid (60° Be) and a solution of ammonia and ammonium nitrate in water are metered in through rotameters. Acid and ammoniating solution come in through adjacent

*A typical mixture would be 10-10-10 (10% each N, P_2O_5, K_2O).

"We rely on lead at every stage of acid handling" says large chemical processor



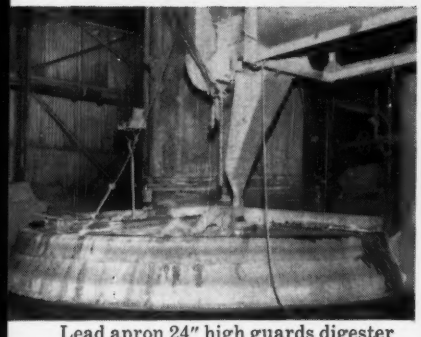
In this leaf filter, manifold and plates are lead



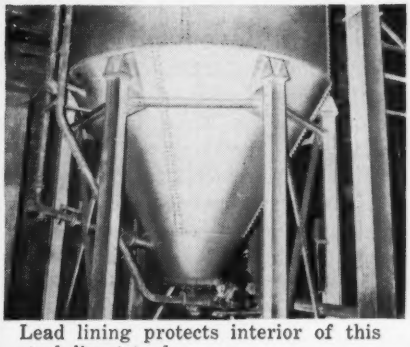
In horizontal filter, rim and concrete supports are lead-covered

In clarification rotaries, lead protects parts exposed to acid

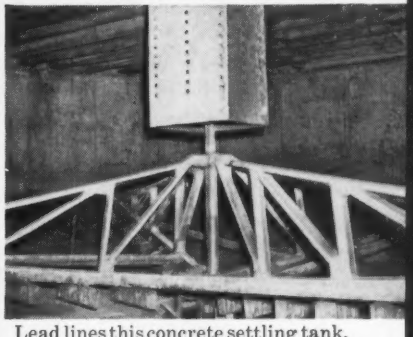
"...in our filters



Lead apron 24" high guards digester rim against spill

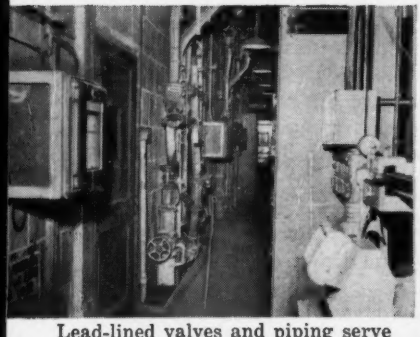


Lead lining protects interior of this steel digest tank

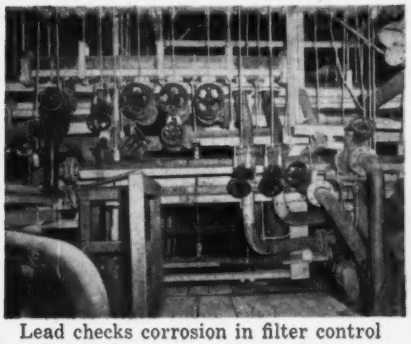


Lead lines this concrete settling tank, covers rake. Plows are solid lead

"...in our tanks



Lead-lined valves and piping serve digesters



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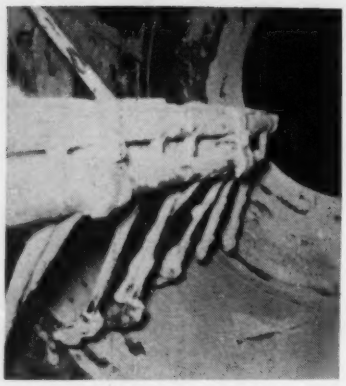


AT NOZZLE outlets, sulfuric and ammonia react to form ammonium sulfate.

nozzles; react at the nozzle outlets, which are placed along a 6-ft. long section of the unit.

Enough ammonia is added to react with the added acid and with the superphosphate. For every pound of acid 1.04 lb. of sulfate forms, and 4,000 Btu. is liberated.

There are limits on how much ammonia and sulfuric can react. These include final composition and allowable working pressure in the combination unit.

▶ **Ammoniation**—This takes place concurrently with sulfate formation. The purpose is to make the phosphorus more readily available for assimilation by crops. Calcium phosphates and ammonium sulfate are the important products of the reaction between ammonia and superphosphate. The presence of moisture and a temperature of about 200 F. aid what is actually a complicated series of reactions.

Moisture and a temperature of around 200 F. are also required in the next step—agglomeration—and this is one reason why ammoniation and agglomeration go hand-in-hand in the new mixing plants.

▶ **Forming Agglomerates**—Agglomeration is a complicated process, but essentially, the small moistened particles assemble into larger, compacted particles by the cementing action of moisture and salts coming out of solution. This takes place in a 26-ft. long flighted section of the unit. Moisture content at this stage is about 10%—a sufficient quantity of liquid phase has to be present to evenly distribute the solids.

For the large number of different formulations made at Ottumwa, additional heat is necessary to produce a dry product. Super-Crop uses flue gas from an oil burner as a source of heat.

Cooling takes place in a separate unit—a 30-ft. long, 5½-ft. dia. rotating drum, with air from a blower. The granules are then packed and shipped.

New Entrants Plan Huge Aluminum Project

Now awaiting a government "certificate of necessity" is a plan to build an $85 million primary aluminum plant. Two companies are involved, neither of which has made aluminum before: St. Joseph Lead Co., New York, and Pittsburgh Consolidation Coal Co., the nation's biggest coal producer.

Though no details have been released yet, likely plant capacity is 50-60,000 tons a year. And since a coal company is participating, there's been considerable speculation that the plant will be located in a coal-producing area.

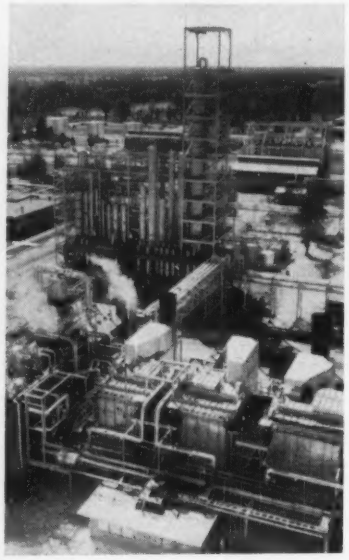
If the certificate is awarded, and it seems probable, this plant may lead off a third round of aluminum expansion. Despite two expansion programs during the Korean War, aluminum is still in short supply. The government has been diverting to private concerns some of the metal earmarked for stockpiling.

Underwater Sulfur Mining Planned

At the Lake Pelto underwater salt dome deposit about 60 miles south of New Orleans, Freeport Sulphur Co. is going to install facilities to mine the sulfur present. It's the first of the firm's properties that's entirely under water (6-8 ft.), which, of course, presents new and difficult problems not faced in coastal marshlands.

Lake Pelto is within a mile of the open Gulf of Mexico. Only a narrow island separates the two bodies of water.

No final decision on the type of process water has been made yet. But since fresh water is a long way off and since Freeport has been successfully using a brackish water technique at its nearby Bay Ste. Elaine mines, it seems likely that the easily available brackish water will get the nod.

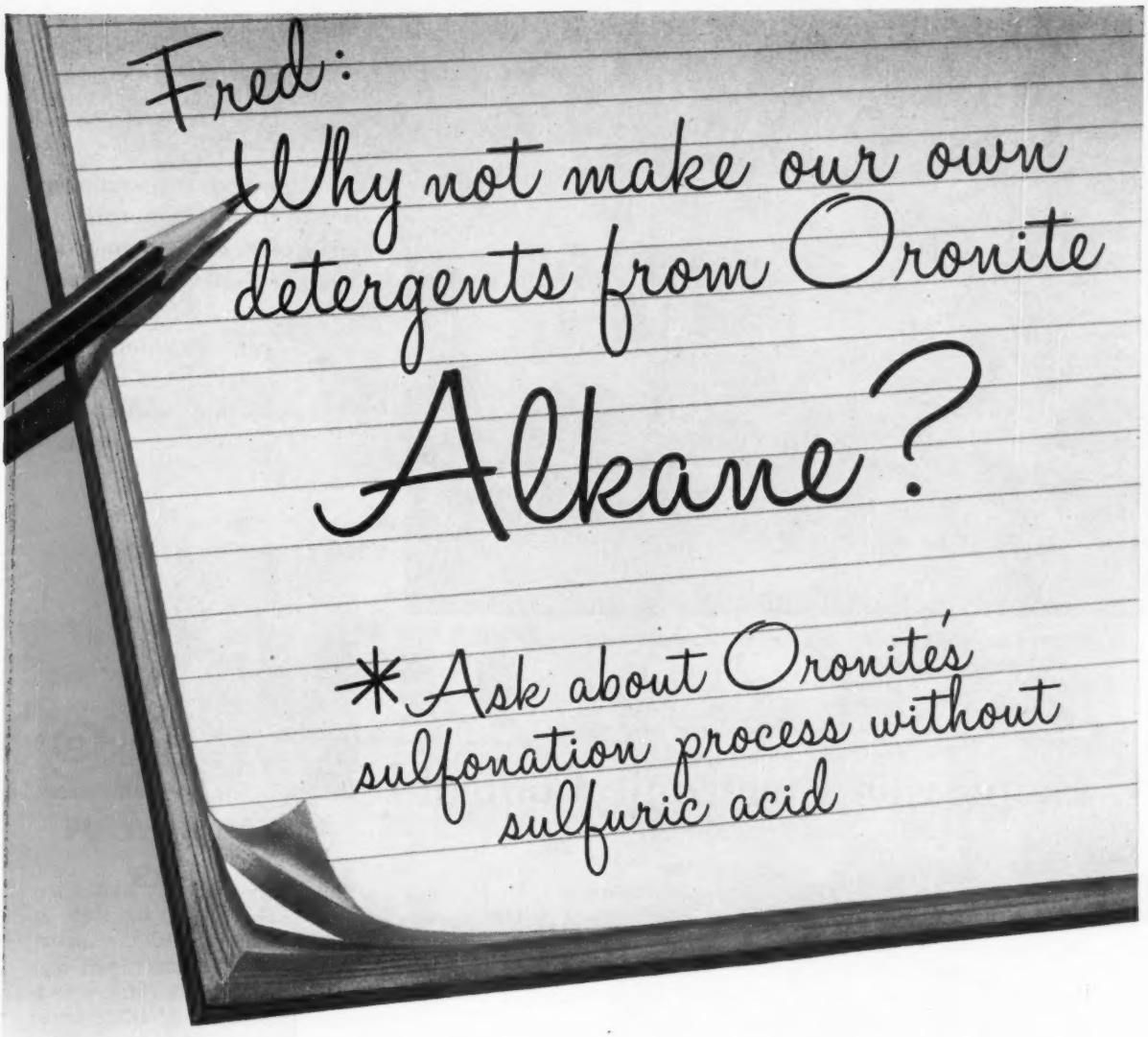


Oxo Expansion Under Way in Texas

Late this fall Texas Eastman will be turning out increased quantities of aldehydes and alcohols from its Longview, Tex., oxo plant (above). Products will include n- and iso-butyraldehyde, which are now made there, and butyl derivatives such as 2-ethyl hexanol, plus propyl aldehydes and derivatives, amyl aldehydes and derivatives and decyl alcohols.

Provisions are also being made for rapid expansion of units making neopentyl glycol and trimethyl pentanediol, both of which are based on isobutyraldehyde.

The Longview operation started up in the spring of 1952. Charge stock is propylene made by cracking East Texas liquefied petroleum gas.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*Ask about Oronite's sulfonation process without sulfuric acid

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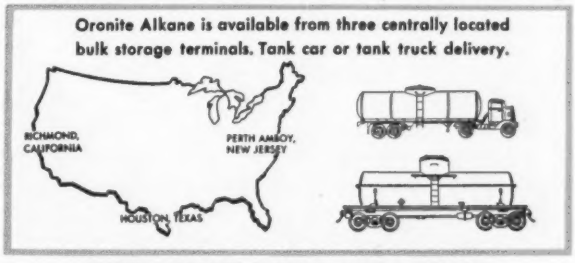
Contact any Oronite office for engineering and manufacturing data and assistance to accurately estimate your complete needs for sulfonation. It costs you nothing.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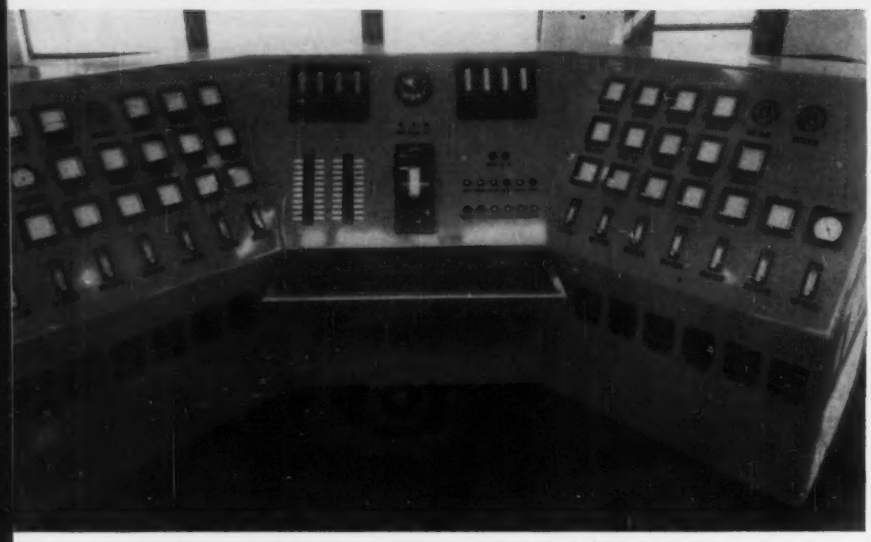
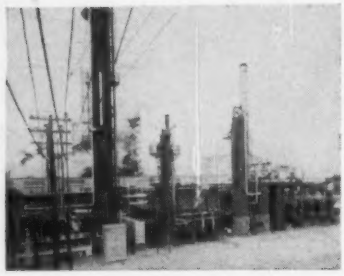


Electronic control systems, such as that used on this Catformer, are proving speedier, more accurate, more dependable. And, despite some problems, they're sparking an instrumentation trend you should know more about.

PIONEERING by refinery units like this highlight today's trend toward . . .



Employing Electronic Control

CONTROL of process variables by electronic systems, recently adopted for several petroleum refining operations, appears destined to play an increasingly important role in the chemical and the petroleum industries.

Some instrument men, skeptical of the method's worth, look upon recent refinery installations as little more than experiments, but the general feeling is strong that within a few years electronic systems will account for a substantial part of all instrumentation.

▶ **Report Success**—Both major refinery installations in the U. S. report a year's successful operation and no maintenance headaches with the electronic system. And many other firms are now testing these controls.

First U. S. refinery unit to use an all-electronic control system was the Indianapolis Platformer of Rock Island Refining, which came on stream last summer. Atlantic Refining's 8,000-bpd. Catformer (pictured above) at Port Arthur, Tex., started operating two weeks later.

▶ **Cites Advantages**—H. K. Ferguson Co.'s Robert A. Duncan, who was project engineer on the Atlantic installation, counts these advantages for electronic over pneumatic systems:

• Eliminates transmission time lag. Transmission of the signal is instantaneous.

• Extends transmission distance indefinitely. Because of the time lag with pneumatic controls, 1,000-ft. transmission approaches the limit.

• Provides greater flexibility in multiple installations. Using electrical signals makes more complex and rapid cascading of controls possible.

• Avoids freezing in cold weather. In pneumatic systems, condensing moisture in the air lines may lead to loss of process control.

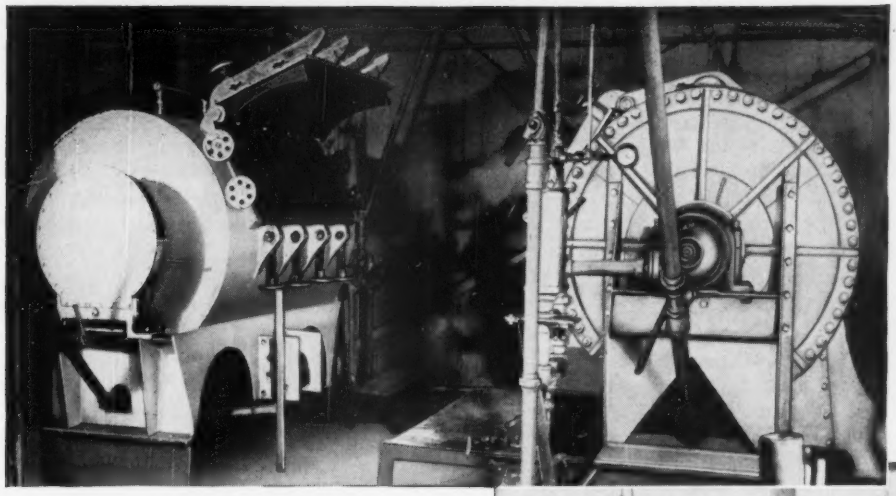
• Does away with complex tubing installations and racks.

• Simplifies maintenance. Lack of moving parts, new long-life (100,000-hr.) tubes and the plug-in feature of the units make it easy to isolate a component which has failed and replace it—making all repairs in the shop, or even returning it to the maker. And, since all recorders and controllers are interchangeable regardless of service, use of an electronic system cuts spare parts inventory. Rock Island terms its control system "practically maintenance free."

• Provides close control with infinite sensitivity. Absence of a mechanical balancing step to convert the electrical signal to a control function means quicker response. In addition, there is no dead band and no hysteresis.

• Holds accurate calibration indefinitely. Once calibrated and set, electronic instruments will control until reset; pneumatic controls are subject to environmental fluctuations.

▶ **Wins Converts**—An electronic controls enthusiast himself, Duncan notes that Atlantic operators and instrument men who were leery of the new method at first became ardent boosters after seeing it operate. They've encountered no unusual maintenance troubles either in startup or operation. (*Cont.*)



Above: Conkey Rotary Leaf Pressure Filters separating coal resins and solvents.

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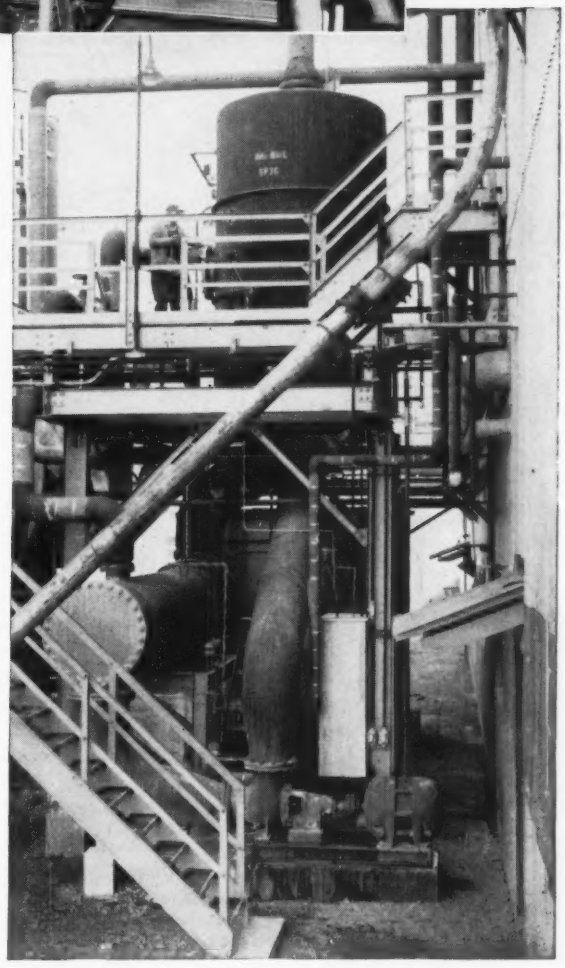
Conkey designed and engineered equipment is fabricated by Chicago Bridge & Iron Company. Four plants, completely equipped to meet the most exacting specifications, are strategically located throughout the country. So when your problems involve crystallizers, evaporators or filters, write our nearest office. There's a Conkey engineer ready to help.



Above: Conkey Horizontal Tube Forced Circulation Evaporator.

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To forestall servicing problems, Atlantic sent one of its instrument engineers to the vendor's plant for training. He returned to instruct operating and maintenance men.

▶**Cautious Approach**—Despite these advantages, most chemical and petroleum firms approach the electronic system with caution. A *Chemical Engineering* spot-check of instrument men in both industries brought out the following objections:

• Need safety standards—Many raise the question of sparking dangers and the resulting fire and exploion hazards around combustible gases. They maintain that some criteria establishing the intrinsic safety of electronic equipment must be set up before its use will become widespread.

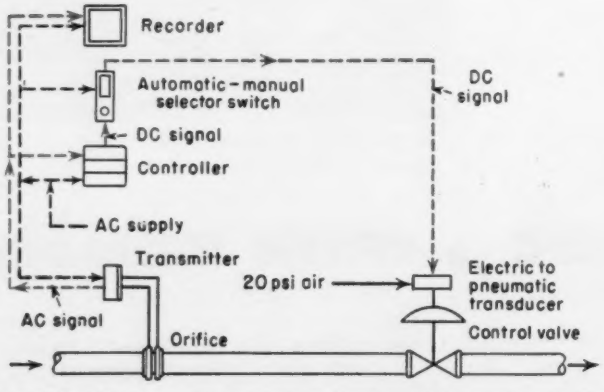
• Final control element—Today's control systems must convert an electrical signal to a pneumatic impulse to operate the control valve. This final control element is a stumbling block, since it makes it impossible to take full advantage of the rapid speed of response inherent in electronic systems. Faster working hydraulically operated valves have been developed, but they're not readily available. Even speedier electrically run control valves are also being developed. Of today's electronic system, one instrument specialist says, "If I need an instrument air compressor anyway, I might as well buy the whole works. Besides, I'll be working with something I'm familiar with."

• Maintenance resistance—Springing an unfamiliar instrument system on maintenance departments also has its problems. Although the instruments are less complicated than the familiar radio, many maintenance people appear to be afraid and distrustful of them, thus creating a servicing problem.

• Emergency standbys—With an electronic system it's sometimes necessary to have a costly emergency power system standing by. With a pneumatic, it's generally possible to continue during a compressor shutdown on a cylinder of compressed air—at least for long enough to shut the unit down in an orderly manner.

• Installed cost—Despite savings promised by better quality control, less downtime and lower maintenance costs, some object to the higher first cost of an electronic control system. At present these systems run 5 to 15% higher than an equivalent pneumatic system. But use of such manufacturing techniques as printed circuits and mass production holds hope of cost cuts.

▶**Short-Range Problems**—Most of these problems appear to be of a short-range nature and will be overcome in time. At present, nearly every major maker of pneumatic controls is developing an electronic system. Two instrument makers, Manning, Maxwell and Moore, Inc., Stratford Conn., and the Swartwout Co., Cleveland, O., now offer complete systems.



FLOW CONTROL is one of the many applications of electronic control systems.

But despite success of the refinery installations, the swing to electronic control is barely starting. The adaptability of the electronic system to further steps in process information handling—such as long-distance data transmission, print out* and, eventually, process programming (the automatic setting, controlling and logging of all process steps) fits it for many future roles. Today's trend is sure to gain momentum.

* Electric typewriters automatically log plant data at predetermined intervals.

Big Chemical Cellulose Plant Will Be Put Up

In about two years, somewhere in North America, Rayonier, Inc., of New York City will be bringing a $30 million chemical cellulose plant on stream. Site is still uncertain, but capacity is pegged at 100,000 tons annually. Most likely location is one of the southeastern states, though company officials point out that there's still opportunity for expansion in Canada. Rayonier now has a $75,000-ton-per-year plant going up on Vancouver Island, B. C.

New German Processes Will Be Available Here

Arthur G. McKee & Co. of Cleveland, by a recent agreement with the Uhde Corp. of New York, can now use a number of important German chemical processes in U. S. and Canadian plant construction. Products included are ammonia and related nitrogen products, carbon bisulfide, formaldehyde, methanol, calcium cyanamide, magnesium, polystyrene, sulfur recovery and zinc dust. Many of these processes have not been widely available in this country.

Uhde, a subsidiary of Friedrich Uhde, GmbH, Dortmund, Germany, will do primarily process engineering and sales development. McKee will do the design, procurement and construction.

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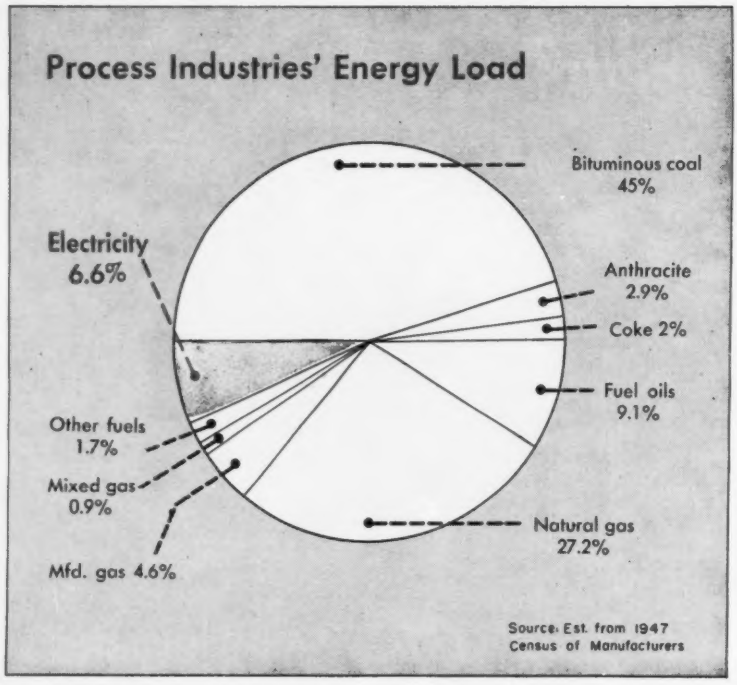


New Use for Nuclear Energy

Here's how the chemical process industries can capitalize on nuclear energy: by using nuclear reactors as a source of process heat.

Prospect of cheap, available electrical energy from nuclear reactors seems to hold little in store for the chemical process industries. Why? A look at the industrial energy load (see cut) shows that only 6.6% of all energy consumed by these industries is electrical.

How, then, can chemical plants put nuclear energy to work? One reactor market being eyed by nuclear scientists is that of supplying process heat.* This can be done in either of two ways:

- Firing high-temperature furnaces directly with nuclear energy.
- Substituting nuclear fuel for conventional industrial fuels to generate process steam.

► **High-Temperature Processes**—One project now being considered by AEC and the Bureau of Mines is the production of synthesis gas—from coal and steam—in a nuclear reactor.

Should this process prove feasible, its value to the chemical industry might be two-fold: It could (1) provide a cheaper synthesis gas for production of chemicals and synthetic liquid fuels and (2) open the way for nuclear energy to facilitate other high-temperature reactions which, to date, haven't been economical.

Present plans call for AEC to design and build a reactor to produce temperatures between 2,000 and 3,000 F. Pulverized coal and steam would be injected into a pipe running through the reactor to produce synthesis gas—using reactor heat.

► **Reactor Pipe, a Problem**—Major problem anticipated by AEC engineers is not nuclear reactor design, but rather materials of construction for the chemical reactor pipe. These materials must have good high-temperature stability, good heat-transfer characteristics, as well as good resistance to nuclear radiation.

Right now silicon carbide seems to offer the greatest promise. But it, too, poses several problems: It must resist erosion by pulverized coal sent through it; resist corrosion from molten coal-slag particles; have a low gas permeability so that the reaction can be run at pressures approaching those at which synthesis gas is conventionally used.

Tests for erosion, corrosion and permeability characteristics will be made at the Bureau of Mines' Morgantown, W. Va., laboratory—by electrically heating a fabricated silicon carbide tube and duplicating intra-reactor temperatures. Successful results will signal AEC's start on the new reactor design.

► **Replacing Conventional Fuels**—Turning to the possible substitution of nuclear energy for conventional fuels, two questions come to mind: Will atomic fuel be cheaper? Where can it be used?

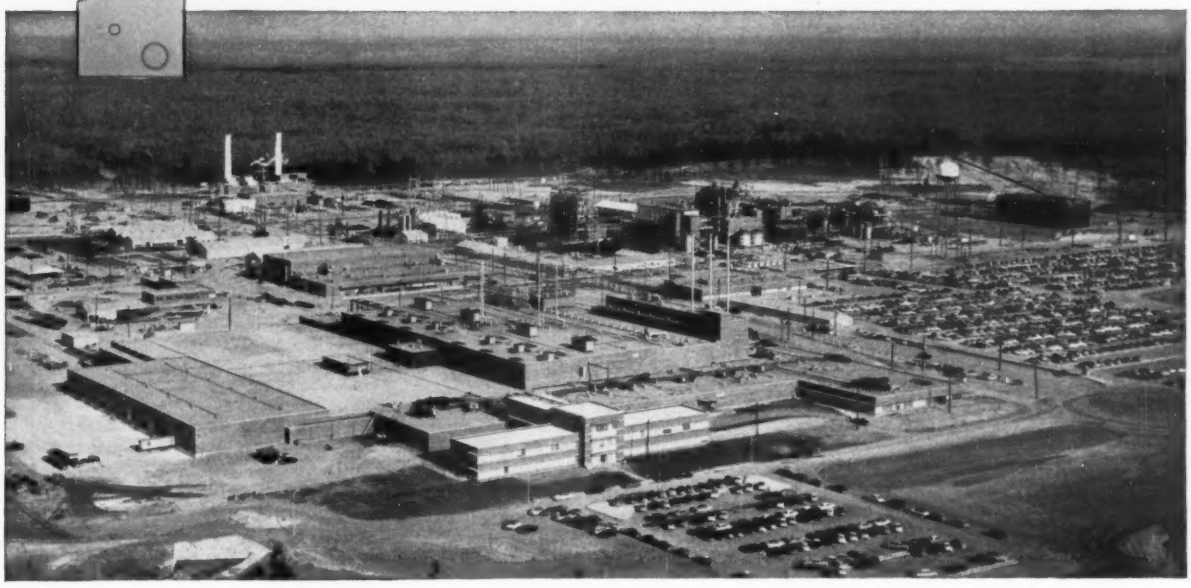
Some answers to these questions were presented by Robert P. Petersen at a meeting of the Atomic Industrial Forum at San Francisco on April 4.

► **Cost Vs. Cost**—Petersen, director of nuclear research for Republic Steel Corp., thinks that considerable cost savings may eventually lead to use of nuclear fuel to replace conventional fuels. He agrees with those who predict that the cost of nuclear fuel (per million Btu.) will be less than 10¢, compared with the national average fuel cost of 25¢. (*Continued*)

* As distinguished from space heating. At AEC's Hanford plant, waste heat from plutonium production will be used to heat the reactor building. Process water from the reactor will give up heat to an ethylene glycol solution which, in turn, will heat air circulating in the building.

three FW Dowtherm heating units supply

24,000,000 btu/hr



at new CHEMSTRAND NYLON plant

Two of the three 8,000,000 btu/hr, 650F, 58 psig Dowtherm vaporizers installed in Chemstrand's new nylon plant at Pensacola, Fla.

In this huge, modern plant at Pensacola, Fla., the Chemstrand Corporation is now operating the first wholly integrated nylon manufacturing unit in the United States. Here nylon yarn is produced from raw materials to finished product in a single plant.

The synthesis of hexamethylenediamene adipate from its component elements, and its subsequent polymerization, require high temperatures which must be very closely controlled throughout the various processes. These exacting thermal requirements are met by three 8,000,000 btu/hr Dowtherm vaporizers, engineered, manufactured and installed by Foster Wheeler.

Wherever industrial processes call for indirect heating with pinpoint temperature control, in the 350F to 700F range, low-pressure Dowtherm systems by FW offer many important advantages. For the complete story, send for your copy of Bulletin ID-54-5. Foster Wheeler Corporation, 165 Broadway, New York, 6, N. Y.

FOSTER WHEELER

▶**Moderate-Pressure Steam**—One area where this cost saving could be realized is in the substitution of small reactors for conventional steam boilers—to produce moderate-pressure (less than 300 psi.) steam.

Much of the fuel consumed by industry goes into the production of steam in this pressure range. And about 25% of all industry-installed boilers have heat capacities of at least 25 megawatts.*

Over a ten-year period, steam from a conventional boiler would cost $85 per heat kw.—$15 to write off initial investment plus $7 per year fuel cost. But atomic fuel would cost less than $3 per year per heat kw. Thus, the capital investment in a moderate-pressure steam reactor could be as high as $55 per kw. of heat.

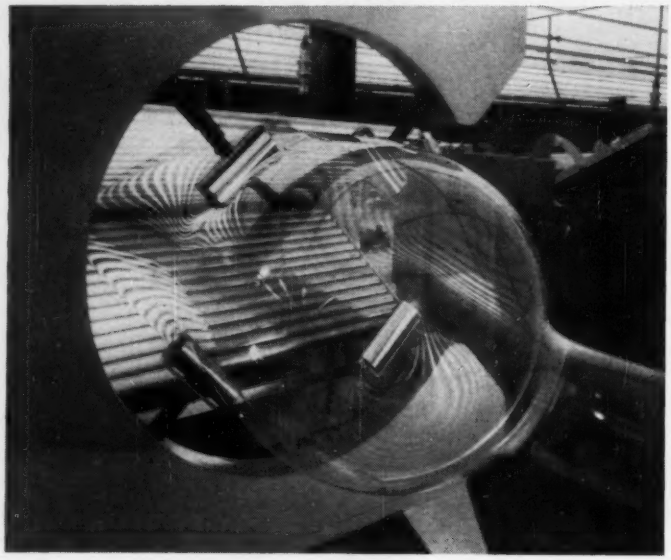
▶**Economically Feasible?**—While reactor engineers now regard a capital investment of less than $55 per heat kw. as reasonable for large reactors (180-700 megawatts), many, says Petersen, doubt that such low costs can be achieved in much smaller units (10-20 megawatts).

Yet, he notes, data obtained from operating small reactors—e.g., CP-3, NRX—can be applied to cutting capital costs of 10-20 megawatt, moderate-pressure steam reactors. For example:

- Expensive materials, like zirconium, can probably be avoided.
- Critical assembly construction cost needn't be high (as it is in the case of graphite and natural uranium systems).
- Instrumentation costs can be cut if the designer differentiates between what's needed for normal reactor operations and safety and what's added for aesthetic or super-safety reasons.

Petersen feels that the time has come for reactor engineers to change their approach. Instead of looking for new reactor applications, they should say, "Here's a need for heat. What kind of reactor can do the job?"

* 1 mw. = 3,415,000 Btu./hr.; 1 kw.-yr. = 30,000,000 Btu.



Stretching: Important Step for Saran Wrap

So far, Dow Chemical is very enthusiastic about its initial sally into consumer markets. The product, of course, is Saran Wrap, a relative newcomer in food packaging. Made of saran film, a vinylidene chloride-vinyl chloride copolymer, its major advantages are excellent moisture proof and vapor barrier properties.

To make the wrap, Dow heats saran molding powder, then extrudes it into a tube form. The film is oriented, or stretched, by injecting compressed air to form a bubble (above), averaging about 80 inches in circumference. The tube is then compressed, wound, slit and rewound into rolls.

All output comes from Dow's Midland, Mich., plant, which was just officially opened. Capacity is over 5 million rolls a month—about 550,000 lb. Initial sales in late 1953 were only 130,000 rolls a month, but by August 1954 had increased to more than 3 million rolls monthly.

Mammoth Expansion Set for Cement Firm

At 10 different locations, Ideal Cement Co. of Denver is going to spend a total of about $55 million to boost its over-all annual cement capacity from 21.5 million to 31 million barrels. Biggest single outlay—$8 million—will be at Houston to double present capacity of 4,000 bbl. a day.

Other expansions are: Ada, Okla., $6.5 million; Trident, Mont., and Redwood City, Calif., $6 million each; Mobile, Ala., $5.5 million; Superior, Neb., $5 million; Boettcher, Colo., $4.5 million; Baton Rouge, La., and Okay, Ark., $3.5 million each; New Orleans, $1.35 million. Since 1945 Ideal has spent $44 million in plant improvement and expansion.

American Enka Moves to Get Into Rayon Staple

The third of three big rayon expansions will get underway this fall. American Enka Corp., now a producer of viscose filament rayon, is adding a $20 million unit at Morristown, Tenn., to make 50 million lb./yr. of rayon staple fiber.

Other producers expanding:

another example of

Production Controlled

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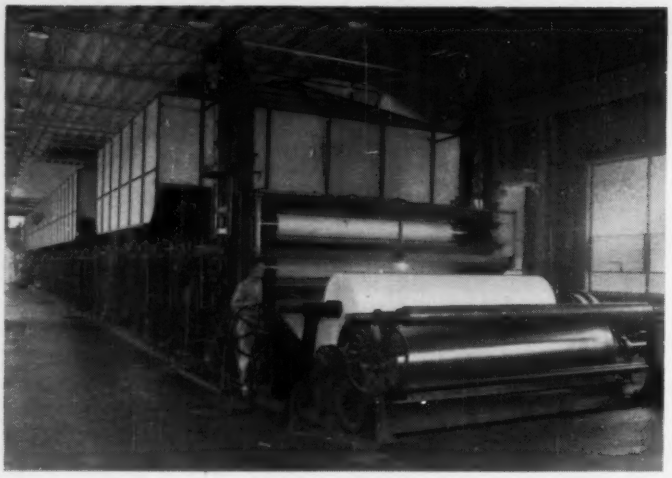


Louisiana Bagasse-to-Paper Mill Will Expand

Capacity of the only U. S. plant making paper from whole sugar cane bagasse is being boosted from 50 tons daily to 75. Located near Lockport, La., it's run by Valentine Pulp & Paper Co. Conventional paper machines are used (above). The Valentine process (Chem. Eng., July 1952, p. 286) uses all the cane, including pith. It produces mostly letterpress and offset printing stock, white tablet and envelope paper. However, a few special runs have been used as newsprint by 25 Louisiana newspapers.

Courtauld's (Ala.), Inc., is boosting staple capacity by 100 million lb./yr. American Viscose plans a 90 million lb. expansion. These three will raise U. S. staple capacity by more than 60% by the end of next year.

Demand for staple has been rising steadily because of more blending of rayon with cotton and the newer synthetic fibers and because tufted carpet makers are turning to rayon. Staple and filament are chemically the same. The difference is that filament is made in long, continuous strands, while staple is chopped into short strands, then spun into yarn as are cotton and wool.

Dimethyl Terephthalate By New Technique

For Hercules Powder Co., oxidation processes are in the spotlight. Very recently the company revealed some possible expansions using its cumene-type oxidation-cleavage process (*Chem. Eng.*, July 1955, p. 108). Now, almost in the same breath, comes word that the firm's $4 million dimethyl terephthalate plant at Burlington, N. J., which uses a new air oxidation technique, is on stream.

The new Burlington plant will supply one million pounds of DMT a month to a new $22 million Terylene plant just started up by Canadian Industries (1954) Ltd. in Millhaven, Ont. The latter has a capacity of 11 million lb./yr.

California Research Corp. granted Hercules basic rights to the air oxidation process for making DMT in the United States. It starts with paraxylene. First, one hydroxyl group is oxidized to the acid, then esterified to the methyl ester. In the second step, the other hydroxyl group is oxidized, then esterified. Hercules' plant is designed for rapid expansion as other markets than Terylene—the same as Du Pont's Dacron—are developed.

Added Capacity for Canadian Kraft Mill

A new paper machine for 50,000 tons a year of kraft papers and newsprint is being built by Crown Zellerbach at Duncan Bay, B. C. In addition, a 400-ton-per-day kraft pulp mill now under construction will be redesigned to produce 500 tons daily and a bleach plant with a daily capacity of 175 tons will be built. The company's current planned expenditures at the location now total $25 million. Production will begin in mid-1957.

Crown Zellerbach is also putting in new facilities, including a 252-in.-wide paper machine, at Antioch, Calif. Capacity is 400 tons a day and it should be ready by the middle of next year.

News Briefs

Glycerine: Dow Chemical expects its new synthetic glycerine plant at Velasco, Tex., to be running by late summer. Process is Dow's own, but is similar to the original Shell Chemical synthesis that started with chlorination of propylene. Capacity will be 36 million lb./yr.

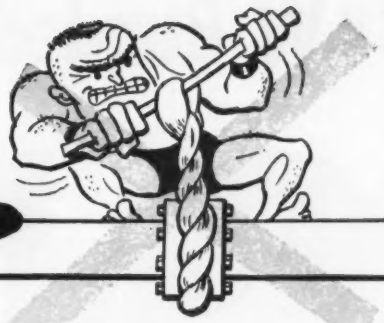
Phosphates: Shea Chemical Corp. is now shipping trisodium phosphate from its new plant at Jeffersonville, Ind.

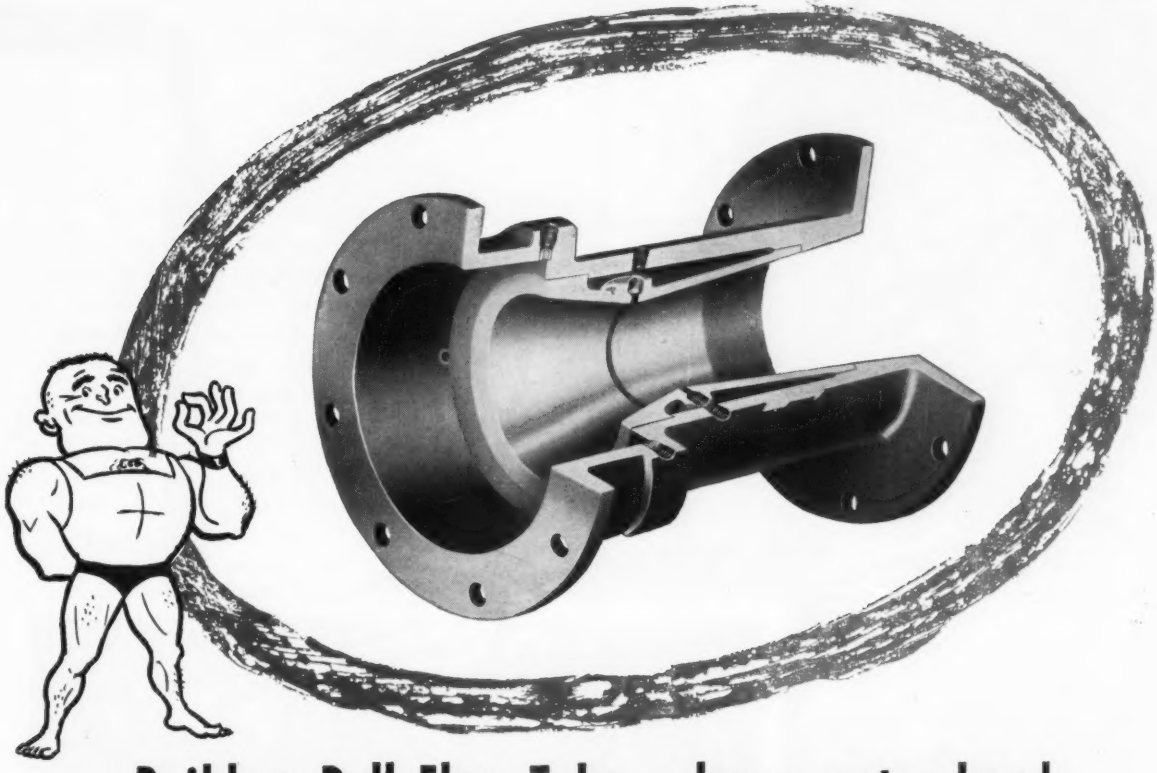
Carbon bisulfide: Stauffer Chemical Co. will build a new multimillion dollar plant at Mobile, Ala., to make carbon bisulfide. It should be ready early next year.

Aniline: National Aniline Div. of Allied Chemical & Dye is building a new aniline plant at Moundsville, W. Va. It will be a duplicate of the one already there.

Chlorine-caustic: Hooker Chemicals, Ltd., is going ahead with the first chlorine-caustic soda plant on Canada's western coast —at North Vancouver, B. C. It will cost $11 million and will be on stream early in 1957.

why pay for flow strangulation?





Builders Dall Flow Tube reduces meter head loss where it counts...at the pipe line!

Here's what you can gain by replacing orifice plates with Dall Flow Tubes in your pipe lines: You reduce pumping costs. You avoid the expense of purchasing over-sized pumping equipment. You gain adequate process flows without building new and costly piping layouts. With it, you obtain top repeatability, long life.

Builders Dall Flow Tube gives maximum pressure recovery — more than any other velocity increasing flow tube. It's compact and economical, too. For complete details, write for Bulletin 115-L1. Also ask for information on secondary instruments. Builders-Providence, Inc., 369 Harris Avenue, Providence 1, R. I.

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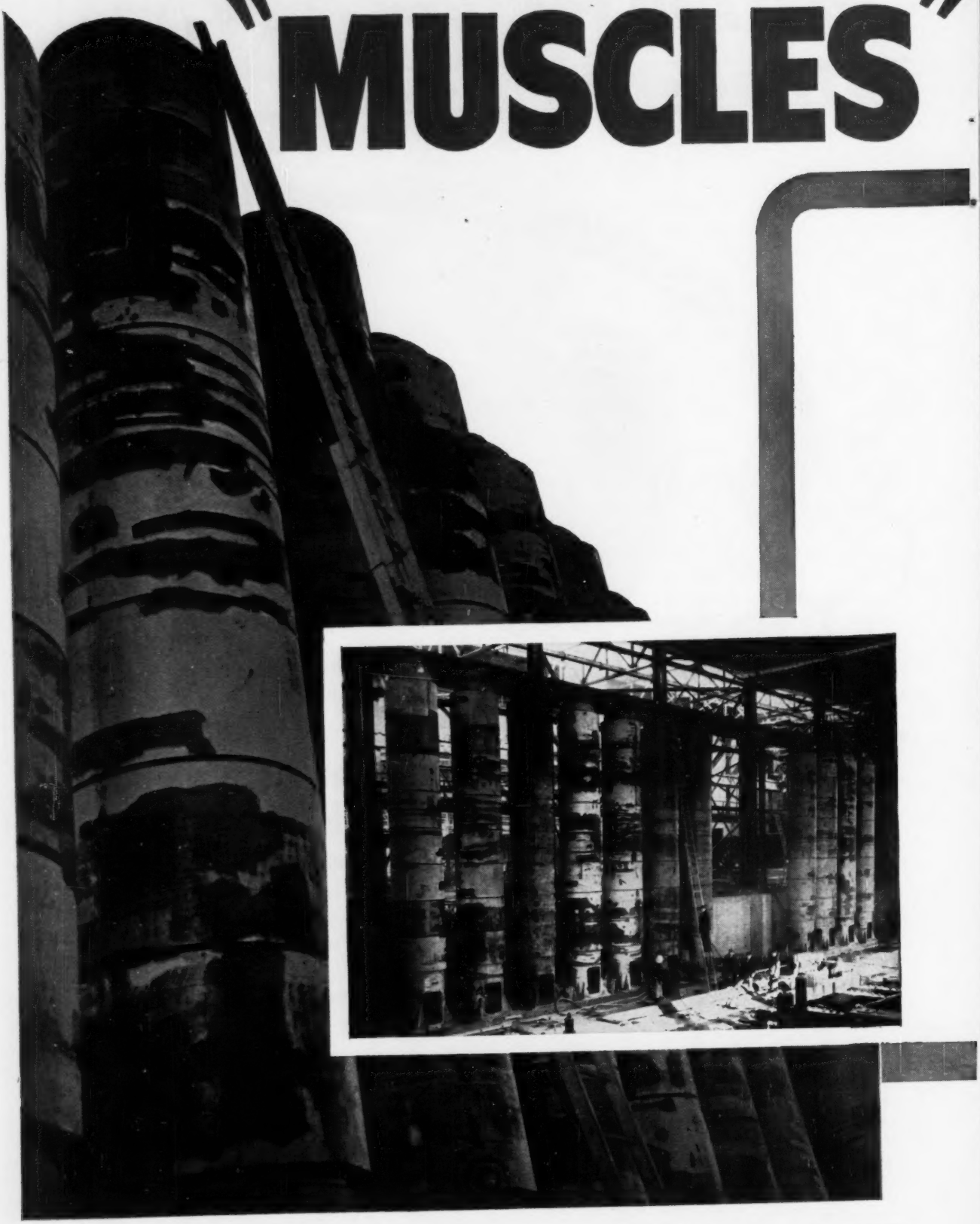
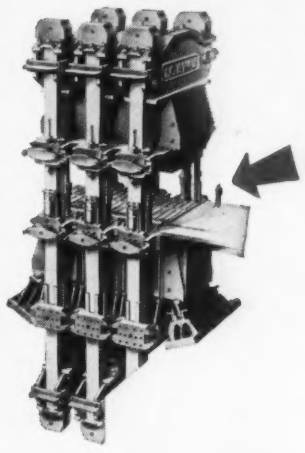


for the WORLD'S MIGHTIEST PRESS

Between strokes of this mammoth press, these seven huge B&W Accumulators will hold in check the tremendous hydraulic force —water at a pressure of 4500 psi—required to operate the largest, heaviest, most powerful production tool in the world. It is a 50,000-ton, ten-story-high, die-forging press built by Loewy-Hydropress, Inc., and now being erected at the Wyman-Gordon plant near Worcester, Massachusetts, for the United States Air Force. When completed it will be perhaps the most effective tool yet designed to aid democracy's defense. And alongside this unit, a 35,000-ton press—to be served by the four additional B&W Accumulator Bottles shown—is also being erected for the USAF.

For high pressure such as this — in the range between 2000 and 6000 psi—B&W Banded Pressure Vessels have a measurable advantage over conventionally constructed vessels. The inner shell—in this instance consisting of 4-inch-thick plate—is fabricated in accordance with ASME Code requirements to withstand longitudinal pressure loading. And to reinforce that shell circumferentially, a seven-inch-thick layer of steel bands is wrapped around it, enabling each accumulator to contain safely, the pressure of the hydraulic fluid.



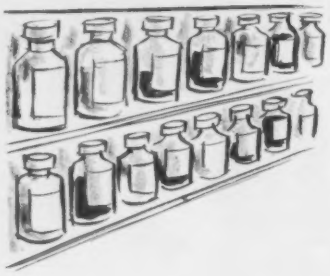
As with these specific bottles, uncompromising care and the most advanced techniques go into the fabrication of every B&W Pressure Vessel. Each production step is performed on equipment designed specially for its job. Much of this equipment as well as many types of construction used, are original B&W developments.

Whatever your operations may be, if they require accumulators capable of withstanding working pressures somewhere between 500 and 6000 psi, with capacities ranging from 5 gallons to 10,000 gallons, it will pay you to get the facts about B&W Pressure Vessels. The Babcock & Wilcox Company, Process Equipment Dept., Barberton, Ohio.

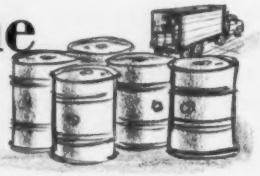
BABCOCK & WILCOX

B-429

Research Chemicals Yesterday—



Now You Can Buy Them in Volume



Studded with double bonds, strung with as many as 22 carbon atoms, new fatty alcohols move into commercial production and beckon to the chemical processor.

Looking for emulsion-stabilizers, corrosion inhibitors, vinyl plasticizers? In the business of making detergents, protective coatings, cosmetics? Interested in long straight-chain alcohols with high melting points, double hydroxyl groups, varying degrees of unsaturation?

Then you'll do well to take a look at the fatty alcohols Archer-Daniels-Midland Co. is prepared to turn out, via sodium reduction, at its new plant in Ashtabula, Ohio. For some of these chemicals have never before been available in commercial quantities (See table, next page). And ADM means and expects to produce them in volume, for it has built a plant that can make up to 20 million pounds of fatty alcohols a year.*

▶**Choice of Properties**—Twelve normal alcohols†—saturated and unsaturated—in 29 different composites are offered by ADM. Some of the individual alcohols have as many as 22 carbon atoms and as many as five carbon to carbon double bonds. Two even boast a pair of hydroxyl groups for greater utility. And you can have oleyl alcohol in its purest commercial form.

The alcohol mixtures have striking properties, too: an iodine value of 190; a melting point of 156 F.; a fire point of 435 F.; a hydroxyl value of 362.

Some of the alcohols occur in mixtures of various proportions: e. g. lauryl in five grades ranging from 48 to 90%; oleyl in five grades with cloud points ranging from 92F. to 46 F. (nearly 100% oleyl).

▶**Crystal Ball**—Many of these chemicals are so new that their industrial potentials have not been fully or precisely evaluated. But conjecture about the future might go something like this:

• High molecular weight imparts low water solubility. Look for ADM fatty alcohol derivatives in water repellent formulations which could be bonded to leather fiber.

• High unsaturation promises better condensation reactions, with such compounds as phthalic and maleic anhydrides, than those obtainable with lower molecular weight saturated alcohols. Look for new alkyd resins and plasticizers to sprout from these reactions.

• High and molecular weight of these alcohols also makes possible the synthesis of olefins that might otherwise be unobtainable. Heavy fatty olefins are being investigated by rubber, petroleum, synthetic fiber and detergent manufacturers.

• ADM fatty alcohols are prime candidates for epoxidation, give excellent vinyl plasticizers that provide built-in stabilization (HCl acceptance during end usage).

▶**Logical Entry**—The Ashtabula

* This could entail an annual consumption of several million lb. of metallic sodium produced by ADM's Ashtabula neighbor, National Distillers Products Corp., located, literally, "across the street."

† Other ADM alcohols besides eight in table: lauryl, cetyl, oleyl and stearyl.

Celite Filtration assures perfect clarity—

adds eye appeal and buy appeal to food products

TO GIVE foods and beverages that extra quality which results in more sales appeal, leading processors depend on Celite Filtration. The Celite method provides perfect clarity at high production rates.

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*Celite is Johns-Manville's registered trade mark for its diatomaceous silica products.

JOHNS-MANVILLE JM PRODUCTS

Johns-Manville CELITE INDUSTRY'S STANDARD FOR FINEST FILTRATION

Unusual Properties . . .	mark new normal fatty alcohol blends	
Two OH groups Hydroxyl value: 362	Ricinoleyl (C_{18}) Saturates	— 88% — trace
Iodine value: 190 Three double bonds	Linolenyl (C_{18}) Saturates	— 51% — 11%
Two OH groups Melting point: 156F.	1,12 Hydroxy Stearyl (C_{18}) Unsaturates	— 87% — 3%
Two double bonds	Linoleyl (C_{18}) Saturates	— 53% — 14%
Four and five double bonds 20–22 carbon atoms	Arachidonyl (C_{20}) Clupanodonyl (C_{22}) Saturates	— 20% — 25% — 15%
20–22 carbon atoms	Arachidyl (C_{20}) Behenyl (C_{22}) Unsaturates	— 38% — 29% — trace
Boiling range: 342–377 F. 22 carbon atoms	Behenyl (C_{22}) Unsaturates	— 85% — trace
Cloud point: 81 F. 22 carbon atoms	Erucyl (C_{22}) Saturates	— 88% — trace

plant marks ADM's first venture in chemical synthesis of fatty alcohols. All the company's earlier alcohols, like cetyl, stearyl and oleyl, were physically separated from sperm oil.

Long a major supplier and processor of marine and vegetable oils, ADM is well grounded in raw materials for production of many more fatty alcohols. Sperm oils and other marine oils will come from Wyandotte, Mich., and Elizabeth, N. J.; linseed and soybean oils from Buffalo, Minneapolis and Decatur, Ill. ADM plans, also, to make fatty alcohols at Ashtabula from cocoanut and castor oils and from tallow.

Form and extent of output is geared, of course, to trade acceptance of the alcohols. In order to get up steam in a hurry ADM will push lauryl and other more familiar alcohols hardest at first. But the firm expects demand for the newer alcohols to build up quickly inasmuch as pilot plant samples have been out for some time, evaluated and found promising by major chemical manufacturers.

▶ **Why Not Before**—Archer-Daniels-Midland and other firms may have been reluctant to invest heavily before this in facilities for sodium reduction of fatty oils to alcohols because of the absence of a third supplier of metallic sodium (other than Du Pont and Ethyl Corp.).

Another possible deterrent in previous years: existence of patents covering production and use of fatty alcohols, patents held by a prime sodium producer.

Several years ago another source appeared in the person of National Distillers which went into the sodium business at a time when government concern over a possible monopoly situation in sodium created a climate most propitious for another competitor.*

With added availability of metallic sodium and a more favorable patent situation today, ADM probably feels more bullish about its chances in synthesized fatty alcohols by way of the sodium reduction route.

However, ADM is not pinning all its hopes on sodium reduction. Realizing that catalytic hydrogenation may well provide the cheapest route in many cases to saturated alcohols, the firm is working towards that end. In fact they are hopeful of improving on those catalytic processes currently offered (*Chem. Eng.*, March 1955, pp. 124-126), all of which, they feel, tend to overhydrogenate and yield unwanted hydrocarbons.

Sodium reduction will be the process of choice, though, for ADM's unsaturates. For in this domain specific, almost pinpoint, reduction is required to preserve unsaturation while, at the same time, forming the alcohol. Besides, ADM expects its specialized equipment and techniques will yield refinements and short cuts in the sodium reduction process.
140A

* The Department of Justice doubted that Ethyl and Du Pont were sufficiently unrelated to provide the most vigorous competition in sodium marketing.

Fatty Diethanolamines

Absence of inert diluents makes for 150% activity.

Super Amides L9, GR and GC are nearly pure fatty acid diethanolamines condensates—150% active compared to currently available products at 100%.

Higher purity offers several advantages to alkanolamide detergent makers. Absence of uncombined diethanolamines makes neutralization of the base unnecessary and avoids electrolytes. Reduction of fatty acids and soaps improves hardness stability and, therefore, foam. And the three new products set standards for freedom from color and odor.—**Onyx Oil & Chemical Co., Jersey City 2, N. J.**
142A

Rubber-Based Concrete

Composite material merges much of concrete's durability with resilience of a hardwood floor.

Laticrete, a combination of liquid rubber and special cement, gives without cracking under heavy

FEATURING ALL SEVEN

"TERGITOL" NONIONIC SURFACTANTS

Trade-Mark

NONIONIC NPX

versatile detergent,
wetting agent, and emulsifier

NONIONIC NP-14

oil-soluble emulsifier
and detergent

Nonionic NP-27

aromatic-soluble emulsifier
and wetting agent

Nonionic NP-35

water-soluble emulsifier and wetting agent
in presence of dissolved salts

NONIONIC TMN

wetting agent and penetrant
with good rewetting properties

NONIONIC NP-40

water-soluble emulsifier and
wetting agent above 100°C.

Nonionic XD

outstanding emulsifier
and low-foaming detergent

Here's a cast that gets top billing in the many different types of surface activity, thanks to the specialized talents of the individual performers. Because no one surfactant can play all parts equally well, CARBIDE has developed a large group of TERGITOL nonionics. Each one is carefully designed for maximum efficiency under specific conditions of performance. That's why —whether it's wetting, detergent, emulsifying, or dispersing action—a TERGITOL nonionic will fill the bill.

For more details on these outstanding products, call or write our nearest office for samples and further information. In Canada: Carbide Chemicals Company, Division of Union Carbide Canada Limited, Montreal and Toronto.

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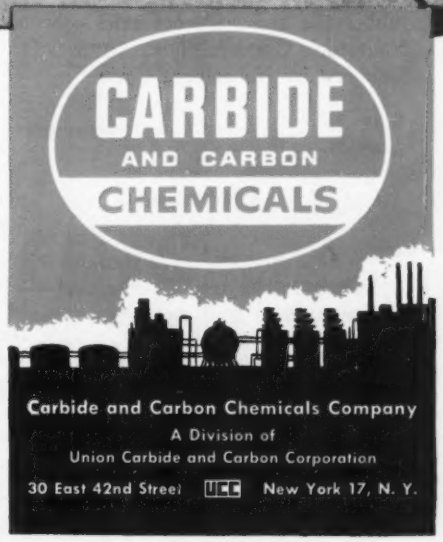

Newsworthy chemicals this month

New fatty alcohols.....140A
Purer diethanolamines.....142A
Rubber-based concrete.....142B
Kaolin catalysts.....144A
Lubricants.....144B
Sulfur substitute.....144C
Low temperature valve lube.....146A
Two new synthetic rubbers.....146B
Aminotriazole herbicide.....146C
Flame-sprayed polyethylene.....148A
Corrosion proofing with chromic acid.....148B
Stronger glass paper.....148C
Stabilized, free-flowing rosin.....148D
Steroid anesthetic.....148E
Ultraviolet light absorber.....148F
Long-lasting fertilizer.....148G
Copper-like porcelain finish.....148H

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loads, dampens noise, resists alkalis and mild acids, is water proof, and has a non-slip quality.

Applicable by standard equipment, Laticrete adheres well to a clean, neutral surface, be it concrete (200 psi.), metal or glass (100 psi.). It cures in two or three days to give a surface which will take compressive loads of 2,500 psi.

Sixty companies are evaluating Laticrete for repairing concrete floors, cushioning pads for heavy machinery, water-proofing interiors of storage tanks, protecting floors and equipment from chemical attack. Other test cases: eliminating dusting from floors in food and drug plants and building non-skid surfaces on ramps for fork lift trucks.

Laticrete costs about 55¢ per sq. ft.—more than asphalt and concrete but less than vinyl and rubber tile and acidproof brick.—**Naugatuck Chemical Div., U. S. Rubber Co., Naugatuck, Conn. 142B**

Catalyst of Clay

Kaolin catalysts, much cheaper than widely used synthetics, perform as well, or better.

An old, well known mineral, kaolin clay—a compound of alumina—gives good yields of high octane gasoline in moving bed (Houdriflow) refinery processes. A purified, pelleted clay, it's expected to sell for a good deal less than $300 a ton synthetics like silica gel impregnated with an alumina compound. Another type kaolin catalyst is testing in fluid cat cracking.

Kaolin catalysts have futures, perhaps, in cat cracking of heavy fuel oil which refiners have running out of their ears what with increased use by industry of gas for fuel. A Houdry process gets better recovery from the residue oil than that from coking same, the present technique, but needs a cheap catalyst to appeal to refiners. These clay catalysts look like the answer in commercial-scale testing.

Abuilding: a $1½ million plant for making kaolin catalysts.—**Minerals and Chemicals Corp. of America, Metuchen, N. J. 144A**

Lubricants

Fluorinated dialkyl esters have more thermal stability than unfluorinated analogs.

Lubricants based on diesters of fluorinated alcohols are not decomposed at temperatures as high as 500 F. and resist oxidation for 168 hr. at 400 F. Many have ignition temperatures ranging from 850 F. to 1,000 F. All that and lubricating ability comparable to petroleum oils.

Esters of fluorinated acids and alkyl glycols are hydrolytically unstable and of less interest as lubricants.

Esters of partially fluorinated alcohols, like $H(CF_2)_nCH_2OH$, appear more useful than those with CF_3 terminal groups, like $F(CF_2)_n CH_2OH$, because they're more viscous, have higher viscosity indexes and lower freezing points, are potentially available at lower costs and in larger volumes.—**Naval Research Laboratory, Washington 25, D. C. 144B**

Sub for Sulfur

Dicumyl peroxide may replace sulfur in many rubber vulcanization processes.

A fundamental shift in rubber processing may be around the corner as dicumyl peroxide vies—cost-wise and performance-wise—for sulfur's top-dog role in the vulcanization of general purpose rubber.

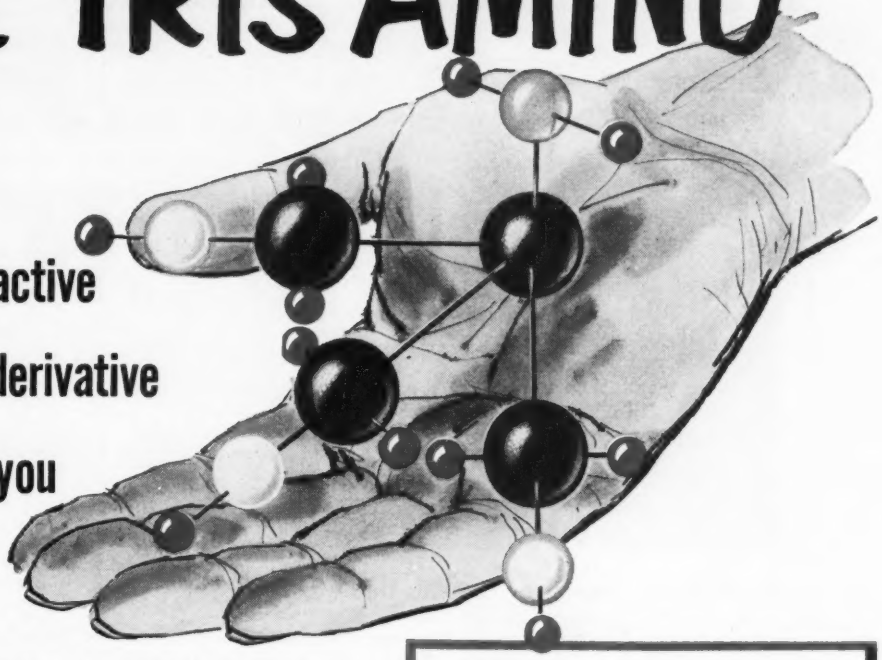
Trade-named Di-Cup, the upstart peroxide boasts these edges over sulfur:

- Outstanding aging resistance of Di-Cup cured rubber is as good, even without antioxidants, as that of sulfur stocks with PBNA added.
- Better low temperature service.
- Unlike sulfur, Di-Cup doesn't discolor or increase opacity of stocks.
- Complete, permanent solubility in the amounts needed to cure all forms of rubber; natural rubber, general purpose synthetics and oil resistant synthetics are vulcanized equally well.

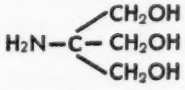
One limitation: high tempera-

meet "TRIS AMINO"

See what this highly reactive nitroparaffin derivative might do for you



"Tris Amino" is short for Tris(hydroxymethyl)aminomethane. This chemical is unique. It is the only tri-hydroxy molecule commercially available having a primary amine group.



Tris Amino is a raw material undergoing a very wide variety of chemical reactions. The reactivity of Tris Amino makes it of unusual interest in chemical synthesis, since it contains a primary amine group *and* three primary reactive hydroxyl groups. Manufacturers of resins, synthetic drying oils, and surface active agents cannot afford to overlook the potential usefulness of Tris Amino as a raw material.

Tris Amino reacts with higher fatty acids to form soaps with unusually strong emulsifying power. Relative high boiling point and low combining weight recommend the use of Tris Amino in preparation of cosmetic creams, textile specialties, cleaning compounds and many other emulsions.

CSC's great new Nitroparaffins plant at Sterlington, La., on stream August, 1955, will assure certain, constant supplies of Tris Amino.

PROPERTIES

Molecular Weight	121.14
Boiling Point, °C	219 to 220 (10mm)
Melting Point, °C	171-172
pH of 0.1M Aqueous Solution at 20°C	10.4
Solubility in Water at 20°C, g/100 ml	80

Other Aminohydroxy Compounds

AB (2-Amino-1-butanol)
AMP (2-Amino-2-methyl-1-propanol)
AMPD (2-Amino-2-methyl-1, 3-propanediol)
AEPD (2-Amino-2-ethyl-1, 3-propanediol)

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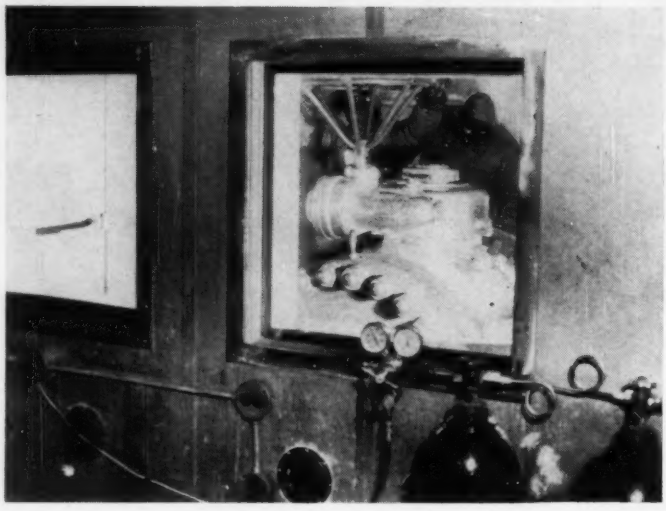

Valve Lube Survives Ordeal Below Zero

Looking like shrouded medieval torturers, the operators of the deep freeze chamber above are putting a new valve lubricant through its paces. Tested in a 24-in. Rockwell-Nordstrom valve, the lube gave a leak-tight seal at temperatures ranging from —50 F. to 70 F., at 50 psi. and 800 psi. line pressure, both balanced and unbalanced on either of the adjoining flanges. Twist to operate valve was not excessive even when using conventional stem packing. Valve was readily lubricated by hand gun at —50 F.—Rockwell Mfg. Co., Pittsburgh 8, Pa. 146A

tures required for cure (290 F. or above). Accelerators to speed up or modify the rate without a temperature rise haven't been developed as yet. But cure rates fall within range of common sulfur-rubber vulcanizates.

Semi-commercial production is under way; larger quantities expected soon.—**Hercules Powder Co., Wilmington 98, Del.** 144C

Two Synthetic Rubbers

One may be cheaper. The other promises greater serviceability.

• Alfin polybutadiene rubber (no styrene) can take up to 1½ times its weight in oil and still retain qualities of good rubber. This makes for a definite cost advantage.

In tests conducted by the Massachusetts Institute of Technology, the oil extended rubber shows the tensile strength, elongation and tear resistance of synthetic rubbers and is compatible with them as well.

• Du Pont's Adiprene B urethane rubber has topnotch toughness and abrasion resistance, doesn't become brittle even at —90 F. and resists deterioration by oils, oxygen, ozone and weathering. Adiprene B differs from other isocyanate rubbers like Chemigum SL in that it is based on an aliphatic polyether, not a polyester, and can be reinforced with carbon black and silicas for further improvement.

It's most obvious potential use is for tire treads. Others: oil field equipment and products calling for abrasion toughness like footwear and conveyor belting.—**Massachusetts Institute of Technology, Cambridge, Mass.; E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.** 146B

From Film to Weeds

Aminotriazole, a chemical used only sparingly in photo film manufacture, looks good as a herbicide.

Encouraged by successful preliminary testing, American Chemical Paint Co. will try its suddenly-popular chemical, aminotriazole, out in earnest on three of the farmer's toughest foes: Canada thistle, quack grass and nutgrass.

Accustomed to only limited use in a special process for photographic film manufacture, aminotriazole looks now like a high powered herbicide for an estimated 50 million acres of land crying for renovation. Tradenamed Amizol, the chemical works by interfering with a plant's chlorophyll supply, stunting growth and sickening the susceptible weed.

Here are highlights from Amizol's test record to date.

• Effective against Canada thistle, more so against this weed than any other known compound, a weed ranked at the top of the national pest list and which could be kept under control only by dosing with large amounts of soil sterilants or repeated application of 2,4-D.

• Effective against quackgrass, a weed so tenacious it has caused farmers to abandon crops and, sometimes, their land. Other chemicals control quackgrass but are unpopular with farmers because of excessive amounts needed and long retention in the soil.

• Effective against nutgrass, a plant pest on almost every farm in the south.

Amizol also works on brush plants—like ash, red maple, poison ivy, and scruboak—that resist 2,4-D and 2,4,5-T treatments. Used as a cotton defoliant, Amizol not only drops leaves from the cotton plant but represses new growth.—**American Chemical Paint Co., Ambler, Pa.** 146C

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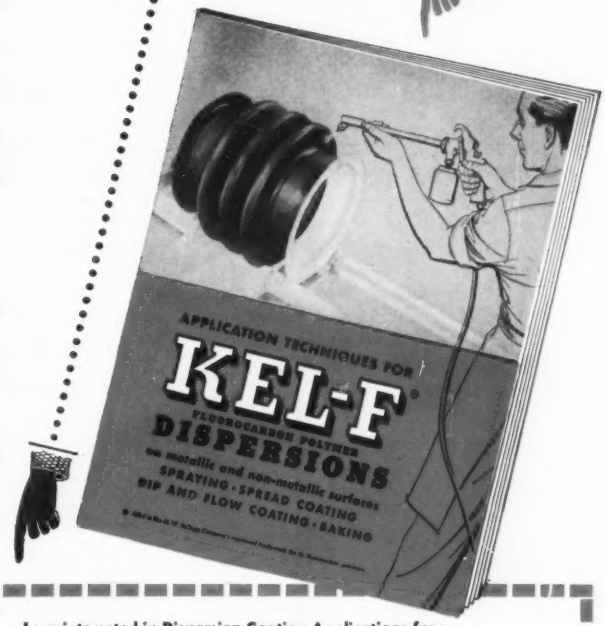
CORROSION CONTROL

in this 20-page KEL-F® Dispersions Manual

Learn how you can get the advantages of KEL-F fluorocarbon plastic: corrosion and heat resistance, anti-adhesion, abrasive resistance, excellent electrical properties, moisture resistance *in a dispersion coating, for application by spraying, dipping or spreading*



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- ☐ shipping containers
- ☐ waste neutralizers
- ☐ agitators
- ☐ calendering rolls
- ☐ forming dies
- ☐ guide rolls
- ☐ mattress molds
- ☐ tire molds
- ☐ ribbon blenders
- ☐ cone blenders
- ☐ hoppers
- ☐ casting molds
- ☐ coated glass tape
- ☐ miniaturized stators
- ☐ distribution transformers
- ☐ miniaturized relays

Other applications (please list) _____

Out of the Flames: a Polyethylene Skin

Field application of polyethylene coatings via flame spray is a ticklish business. Past practice has been to preheat the target to 400-500 F., to spray powdered polyethylene (softened by flame) and bake the coating on by flame. Keeping the poly soft enough to bond with the surface being coated without overheating and degrading the coating calls for judicious use of the flame. Pyrocote Chemicals claims now to have an easier—and therefore surer—way to flame spray poly. It's product, Pyrothene (polyethylene compounded with special addititives), is first melted in special automatic equipment, then sprayed as a liquid on to a target that needs only to be heated to 150-190 F., and finally baked for bonding. Result: more adherent coatings with less chance of decomposition. Ability to deliver polyethylene as a low viscosity liquid spray—flame is used primarily for preheating surfaces and baking the coatings on—is core of new process. And Pyrocote apparently does it without resorting to low molecular weight poly which melts more easily but has rather poor corrosion resistant properties. For Pyrothene is claimed exceptionally inert to dilute and concentrated hydrochloric and sulfuric acid as well as to all other chemicals to which polyethylene, itself, is proof.—Pyrocote Chemicals, Inc., Bayside, N. Y. 148A

Briefs

Good resistance to corrosion and paint flaking can be secured by rinsing previously phosphated metal surfaces with concentrated solutions of chromic and chromic-phosphoric acids.—**Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.** 148B

All-glass paper is now eight times as strong (300 psi.) as that first made in 1951 (30-40 psi). As such it should be more practical as a filter for hot or corrosive fluids, as an air filter, as a saturating or laminating base for plastics, as an electric insulator. —**National Bureau of Standards, Washington 25, D. C.** 148C

Stabilized rosin in free flowing pelleted form comes now as a distinct improvement over older rosin shipped as a solidified mass which must be chopped for use. Galex Pellets, it's claimed, will not fuse at 130 F., will not cake under pressure and are stabilized against oxidation.—**National Rosin Oil Products, Inc., New York 20, N. Y.** 148D

A promising intraveneous anesthetic has evolved from an unexpected quarter—steroid chemistry. Viadril (hydroxydione sodium) is synthesized from steroid-containing raw materials similar to those which form basis for hydrocortisone manufacture, but has no endocrine activity. Used successfully in 130 operations, Viadril works best combined with nitrous oxide. Viadril prevents pain sensitivity, produces muscle relaxation and sleep, but without unduly depressing respiration or circulation. Recovery is rapid with minimum side effects.—**Chas. Pfizer & Co., Inc., Brooklyn 6, N. Y.** 148E

An absorber for ultraviolet light and an antistatic compound for plastics is Stabilite. A 0.001 in. film of Stabilite on plastic surfaces filters out 99.8% of incident ultraviolet light at wave length 400 and 100% at all wave lengths below 390. And Stabilite's antistatic properties help plastic makers turn out dust-free products. Cost for large scale use: 7¢ per 100 sq. ft.—**Merix Chemical Co., Chicago 15, Ill.** 148F

Uramite fertilizer combines a high nitrogen content (38%) with a unique, prolonged, uniform release rate which meets in one application the nitrogen needs for an entire growing season. Only about ten pounds of Uramite per 1,000 sq. ft. are required to produce a more durable, attractive turf.—**E. I. du Pont de Nemours & Co., Inc., Wilmington 98, Del.** 148G

Copper-like porcelain finish for steel products, Coppertan, has beauty and warmth of copper plus durability of porcelain enamel. It will not tarnish or scratch, is acid-resisting. Two layers of covercoat enamels (different colors) are sprayed over ground coat enamel and fired only once to give the coppery finish.—**Pemco Corp., Baltimore 24, Md.** 148H

VERSATILE Boron Trifluoride has rung the bell as a catalyst so many times . . . has "carried through" so many different organic syntheses . . . that some chemical engineers are beginning to think of BF_3 as almost universal in its applications.

THE NEXT synthesis problem it will help solve may well be *yours*. Write today for more detailed information on the properties and some of the uses of Baker & Adamson Boron Trifluoride and its complexes.

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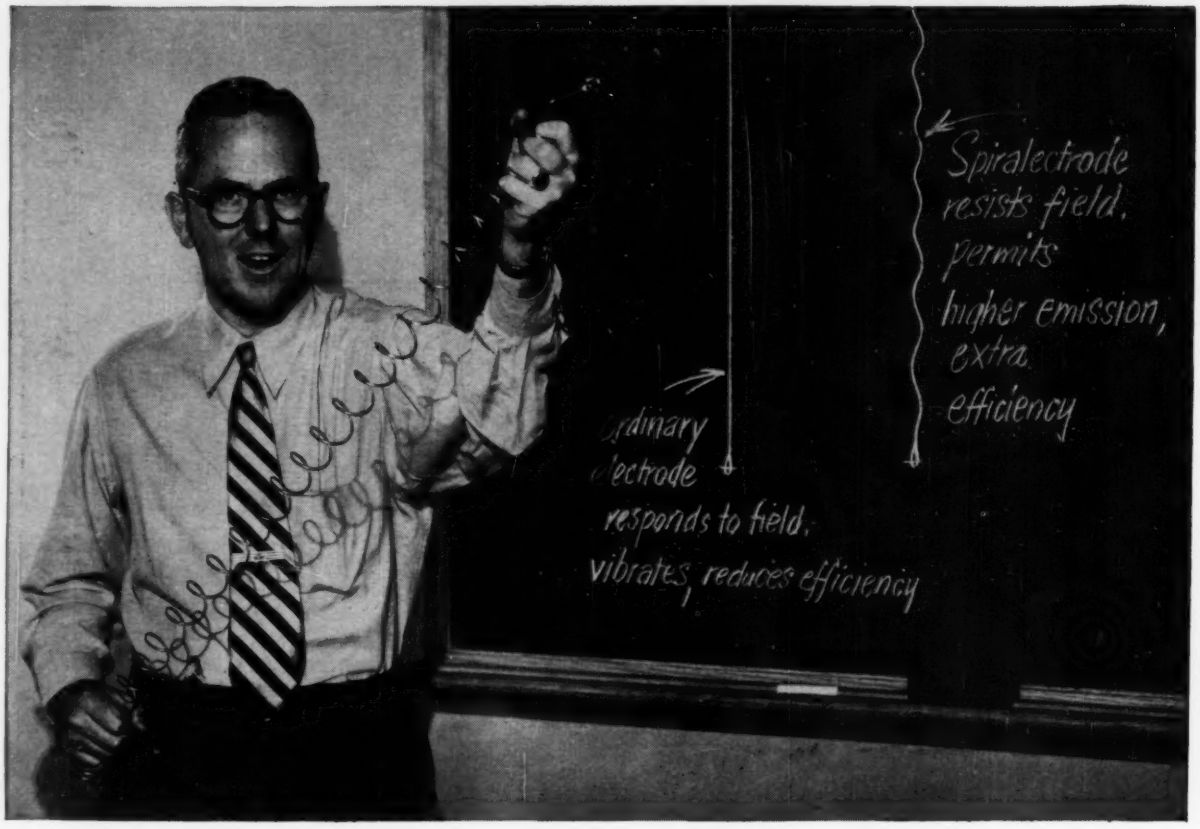
How Buell's Unique Spiralectrodes deliver EXTRA DUST COLLECTION EFFICIENCY!


Spiralectrode resists field, permits higher emission, extra efficiency
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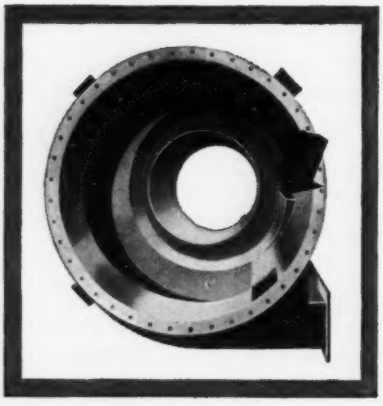
Coupled with the unique spiralectrode feature is Buell's Continuous Cycle Rapping—the most effective mechanism yet developed for dry dust precipitation. Completely eliminates puffing, keeps electrodes constantly clean. Re-entrained dust is minimized, peak efficiency is maintained.



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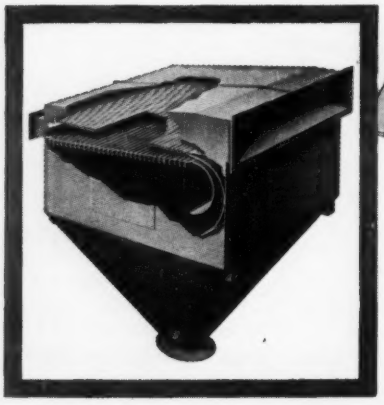
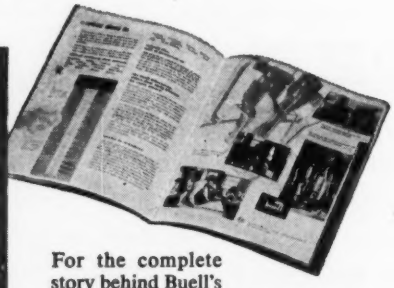


Buell's Low Resistance Fly Ash Collector combines top efficiency with low draft loss, for natural or forced draft installations.



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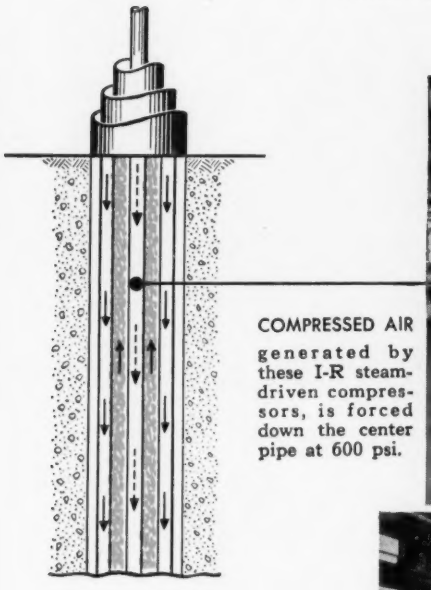
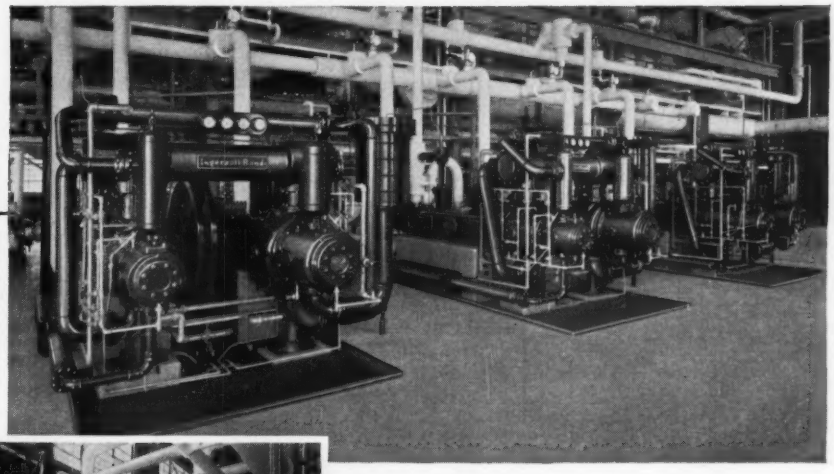
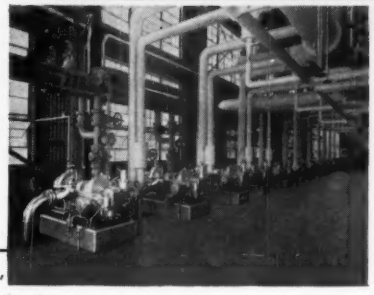
I-R "AIR LIFT" raises sulphur at SPINDLETOP

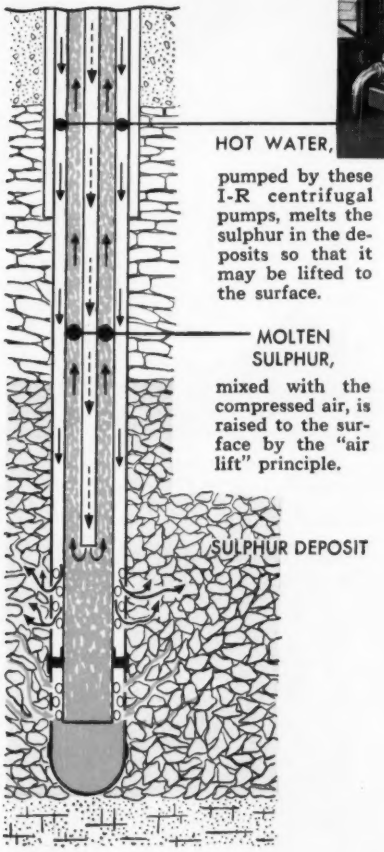


COMPRESSED AIR generated by these I-R steam-driven compressors, is forced down the center pipe at 600 psi.





Newest plant of Texas Gulf Sulphur Company mines molten brimstone with Ingersoll-Rand air and water power


HOT WATER, pumped by these I-R centrifugal pumps, melts the sulphur in the deposits so that it may be lifted to the surface.
MOLTEN SULPHUR, mixed with the compressed air, is raised to the surface by the "air lift" principle.
SULPHUR DEPOSIT

Here at the Spindletop mine of the Texas Gulf Sulphur Company, near Beaumont, Texas, a huge underground deposit containing thousands of tons of sulphur is being brought to the surface in liquid form by the modified Frasch process illustrated at the left. The only mining "tools" are air and hot water. Compressed air forced down the center pipe mixes with the melted sulphur and raises it to the surface by what is in effect an "air lift".

Once started, this operation never stops. Hence the *dependability* of Ingersoll-Rand equipment is particularly important. Power for the "air lift" is provided by the Ingersoll-Rand Type XPV 4-stage steam-driven compressors shown above. And hot water is pumped into the wells to melt the sulphur by a battery of I-R Type JVL centrifugal pumps.

This is another example of how I-R equipment is serving vital industries the world over. Ingersoll-Rand compressors are built in sizes from ½ to 4,000 hp, for pressures ranging from vacuums to 22,000 psi — with any type of drive. Whatever your compression problem, your nearest I-R engineer has the answer.

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How to take the AH-CHOO *out of Benzoates*

You may have a problem that *used* to bother one of our customers.

Seems their production men began to complain of sneezes and sniffles.

The culprit? Benzoic acid dust, hanging in the air in the rooms where these men worked.

The dust wasn't hazardous. But it was bothersome, at the least—and could have become a real morale problem.

SOLUTION: At this customer's request, we developed a *bead form* of benzoic acid, technical.

These tiny benzoic acid beads keep their shape during handling, right up to the time they go into process.

RESULT: No dust. No more sneezes or sniffles. Happier production. And a gratified customer.

If you're using technical benzoic acid, try our bead form and see if it doesn't make a difference.

You can also get *powdered* benzoic acid from us, in both technical and U.S.P. grades. It comes in 25, 50, and 100-lb. fiber drums.

DUST-FREE SODIUM BENZOATE, TOO

Sneezing isn't so much of a problem with sodium benzoate. But if you use ours, it's no problem at *all*. We've managed to perfect a flake form of sodium benzoate that's as nearly dustless as sodium benzoate can be. We do it with a special, tightly-controlled flaking operation.

You can get the resulting clean, nondusting flakes in either U.S.P. or technical grade. (We can supply you with *powdered* sodium benzoate, U.S.P. or technical, too.) If you'd like data sheets, and trial samples of either form to check against your present supply, just write us or phone the nearest Hooker sales office.

BENZOIC ACID, technical, in bead form is nondusting.

SODIUM BENZOATE, flake form, is practically dust-free, thanks to careful screening and packaging.

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From the Salt of the Earth—1955

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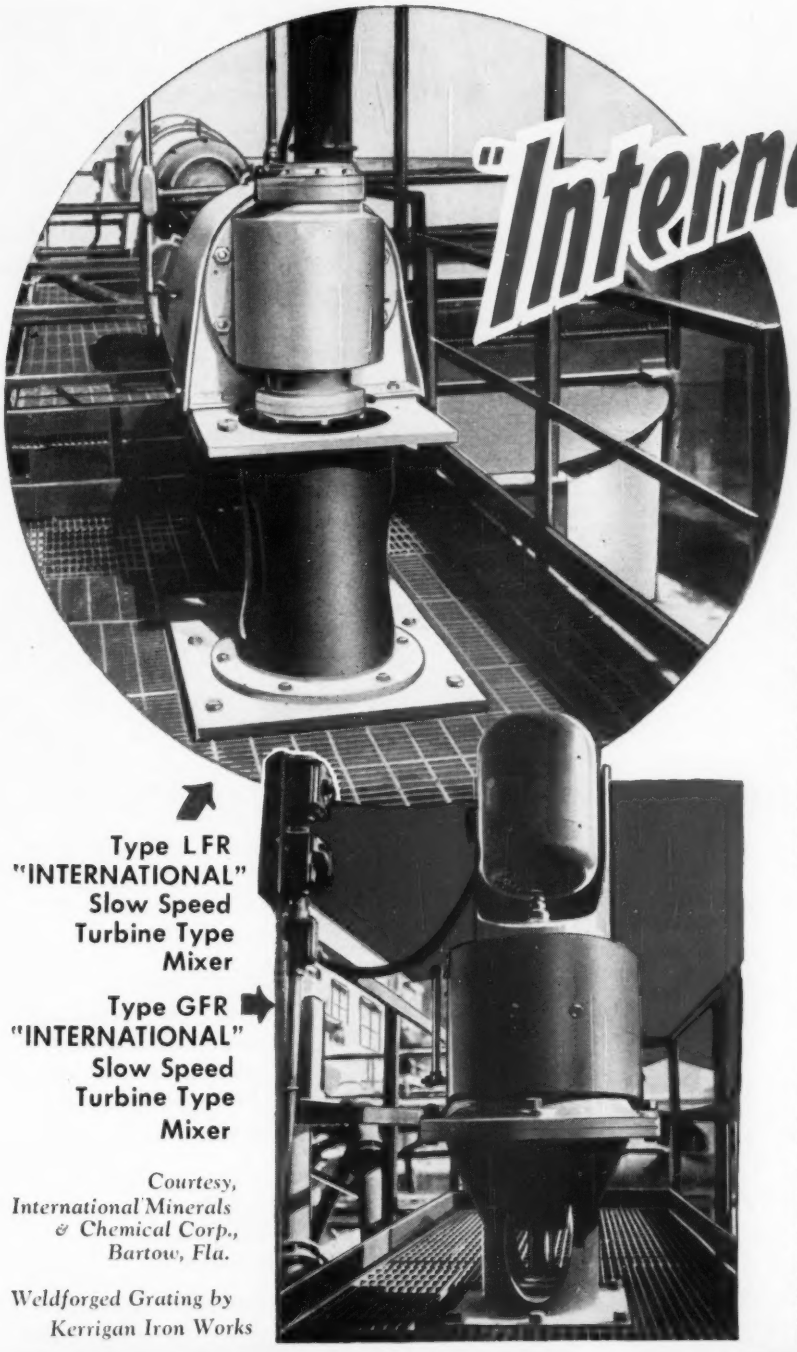
Tailored for the job–

But Basically Designed for Contingent Modification



Type LFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Type GFR "INTERNATIONAL" Slow Speed Turbine Type Mixer

Courtesy, International Minerals & Chemical Corp., Bartow, Fla.

Weldforged Grating by Kerrigan Iron Works

After all, it's PERFORMANCE that counts. Engineers agree that efficiency comes first in profitable operation, and a Mixing unit designed for the purpose at hand (with adaptability to similar operations) will deliver superior performance and optimum results. INTERNATIONAL Mixing and Processing Equipment is preferred by Engineers because they know it is made and Guaranteed for a specific purpose—to do it better and at less cost. It's adaptability to other similar operations is an extra advantage to the user, where modification due to normal process changes become necessary. Motors, Gear Ratios, Shafts and Shaft Diameters as well as Turbine Elements are of course, interchangeable within normal limits, at minimum time and expense.

Wherever you find INTERNATIONAL Equipment you'll find a pleased user—and you'll find it in practically every segment of the Chemical, Pharmaceutical, Ceramic, Industrial and Petroleum industries. Remember to investigate "INTERNATIONAL" when you want Guaranteed Performance.

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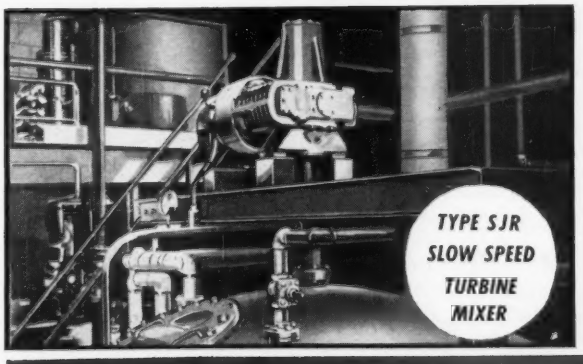
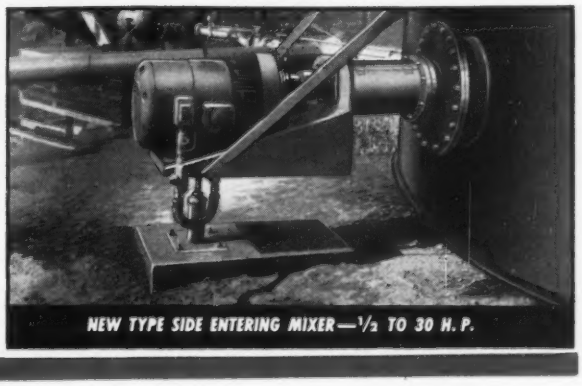
In the interest of intelligent Engineering Cooperation, INTERNATIONAL issues Technical Bulletins on the various phases of Mixing and Processing, which will be gladly sent on request. Simply indicate the subjects in which you are interested.

Top Entering Mixers and Agitators	73-76
Side Entering Mixers and Agitators	72-A
Dry Blenders and Ribbon Mixers	78
Grinding and Mulling Fans	5-A
Portable Mixers	74-A
Mixing and Extruding Machinery	62-A
Ball and Pebble Mills	100
Continuous Mixers	A
Stack Fans and Duct Boosters	109-A
Laboratory and Pilot Plant Equipment	77-A





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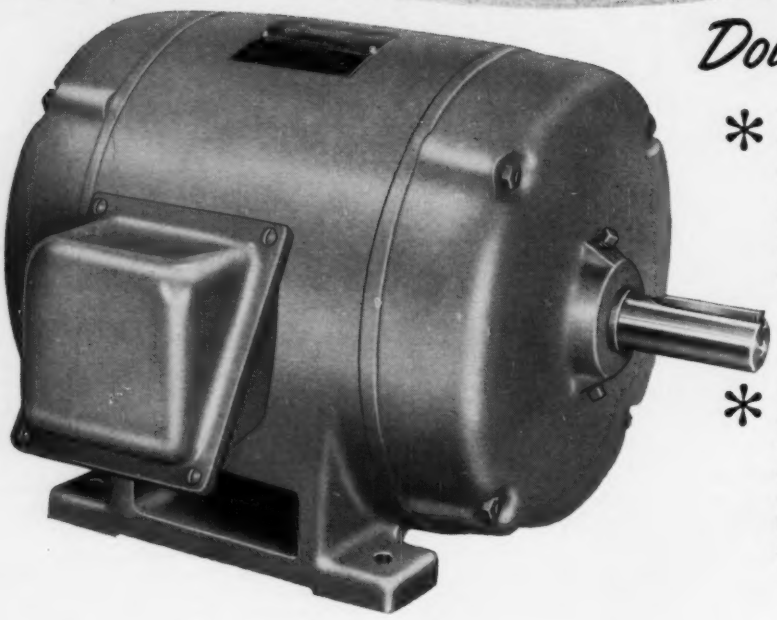


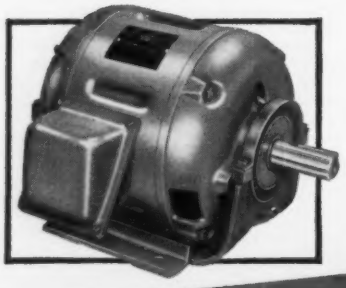
* Wagner Type DP Motors are protected by rugged, corrosion-resistant cast iron frames, smoothly rounded so that no moisture can collect on them. Motor feet are cast as an integral part of the frame for maximum strength and rigidity.

* Enclosures are drip-proof plus! Air intakes are located at the bottom of the endplates — air outlets are located at the base of the frame, one on each side. Specially designed baffles provide protection for the stator windings.

The Wagner line of polyphase, drip-proof general purpose motors—rerated to the new NEMA Standards—pack more power into smaller frames, but give you the same high Wagner Quality and long life performance that have made Wagner Motors "the choice of leaders in industry" for many, many years. These new Wagner Motors are fully protected in the ball bearing models. Their construction makes them completely drip-proof — and virtually splash-proof. The extra large, diagonally split conduit box makes wiring easy. Smaller size and lighter weight means more economical handling and installation.

These new rerated Wagner Motors retain the features desired by plant engineers and maintenance men. They will operate for years without regreasing. But . . . when lubrication *is* necessary or desirable, you *can* lubricate these motors because they are provided with two lubrication openings.

Bulletin MU-202 gives full information—write for your copy today.



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You can look to Wagner for a complete line of standard motors for specialized applications. The wide range of types and sizes permit the selection of a standard motor for almost any need.

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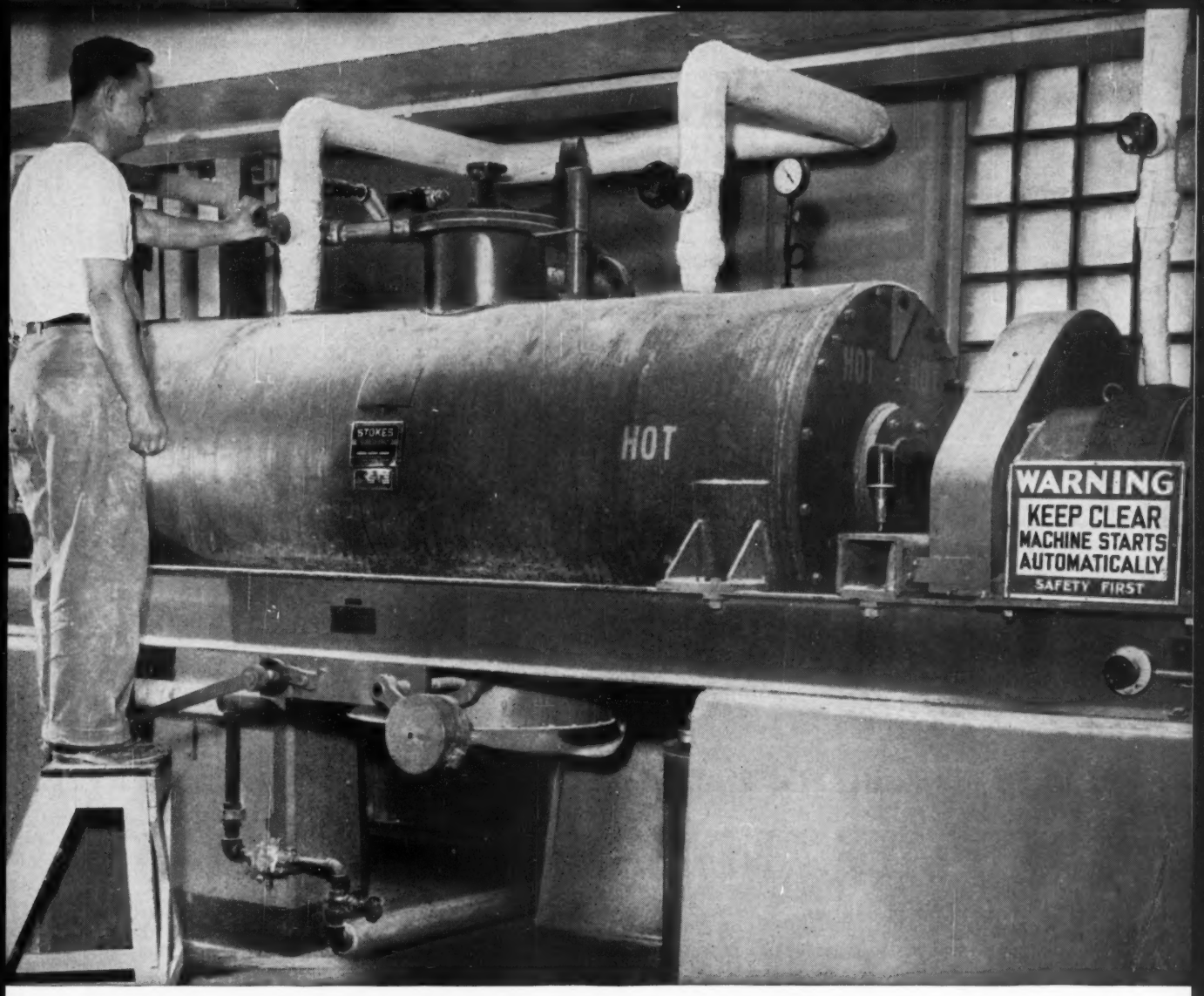


Weed-killer production problem solved by STOKES vacuum dryer

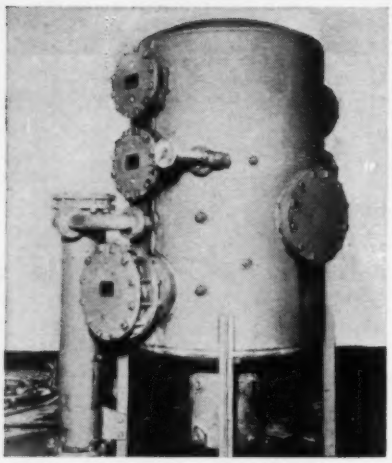
A leading chemical manufacturer asked us, "What equipment can we use to dry 6 tons per day of a heat-sensitive weed-killer from a true solution containing 67% dissolved solids to a crystalline product of 99.75% solids? Maximum allowable temperature is 50° C and we must crystallize and dry in one operation."

Stokes engineers developed the answer from broad experience with drying problems . . . confirmed it by tests on the chemical in the fully equipped Stokes laboratory . . . recommended a Stokes rotary vacuum dryer sized to give the needed production on a predetermined drying cycle. The unit was purchased and is now on the production line.

This combination of engineering knowledge and laboratory research—the result of 40 years in the design and application of complete vacuum processing systems—is available to all chemical manufacturers. A typical Stokes Rotary Vacuum Dryer is illustrated. Write for informative literature on Stokes Vacuum Drying Equipment, Catalog No. 720, and for the new booklet on Stokes Laboratory facilities, Bulletin No. 640.

F. J. Stokes Machine Company,
Philadelphia 20, Pa.

STOKES



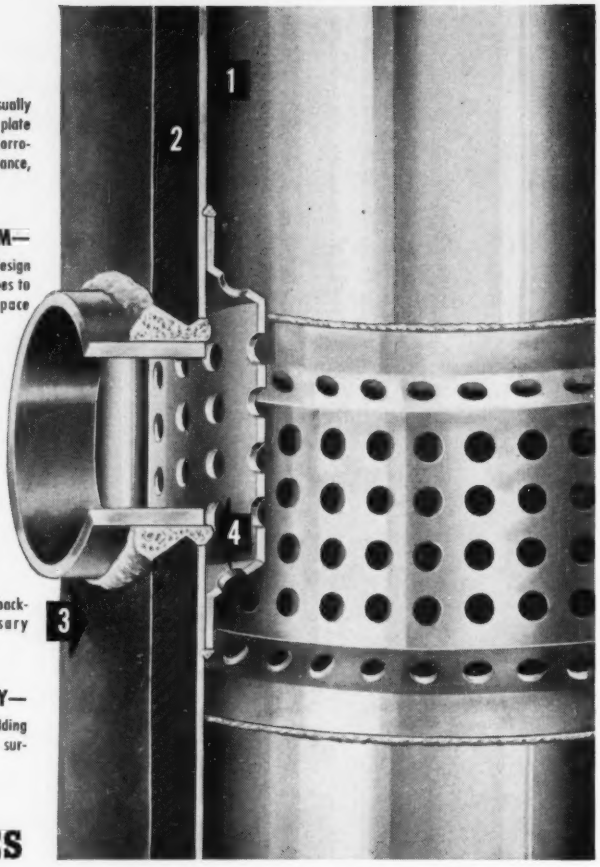
This solvent recovery unit—reboiler, condensing and cooling elements—was fabricated of nickel-clad steel.

1 ECONOMY—
High alloy layer—usually 10% or 20% of total plate thickness — assures corrosion and abrasion resistance, long equipment life.

2 DESIGN FREEDOM—
Integral bond allows design and fabrication of shapes to meet process and space needs.

3 STRUCTURAL STABILITY—
Low-cost carbon steel backing provides necessary strength and rigidity.

4 EASY TO MODIFY—
Normal cutting and welding will not endanger clad surface or bond.



CLAD STEEL EQUIPMENT ASSURES

LONG LIFE AND EASY MODIFICATION

To help you overcome the rapid obsolescence caused by process changes when first costs are high, clad steel equipment offers two unique advantages. First, clad steel construction permits easy tank and vessel revision where new openings must be cut and flanges, pipes or attachments welded on. This means you can design for extra-long service life. The bond between cladding and backing will not tear away and allow harmful seepage.

Second, you get long-life protection from corrosion, abrasion and product contamination—all the advantages of solid, high-alloy construction—with savings up to 50% in material costs. The ASME Code permits full gage consideration for design purposes because cladding and backing are bonded over their entire surface.

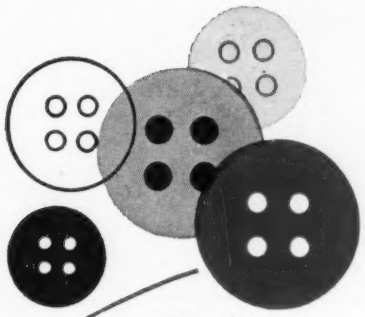
Long life and low-cost protection, plus other advantages like fast heat transfer, easy cleaning and minimum maintenance, can be obtained from 16 cladding materials that meet a wide range of service conditions.

And *qualified* equipment builders know best how to apply these to your new processing equipment. By working with your own engineers and consultants from the start, they can help you get longer equipment life at lower cost. Lukens offers the widest available range of clads—stainless, nickel, Inconel, Monel, copper—and cooperates with fabricators in helping you to select the type best suited to your processing needs. If you would like more information, consult one of your builders or write Manager, Marketing Service, Lukens Steel Co., 749 Lukens Building, Coatesville, Pa.

LUKENS CLAD STEELS

STAINLESS-CLAD · NICKEL-CLAD · INCONEL-CLAD · MONEL-CLAD

PRODUCER OF THE WIDEST RANGE OF TYPES AND SIZES OF CLAD STEEL PLATES AND HEADS AVAILABLE



BAKER PERKINS
SIZE 14 JNM2 UNIVERSAL MIXER
uniformly blends special vinyl compounds for Auburn Button Works, Inc., Auburn, N.Y.

As an intermediate processor of raw materials for plastics fabricators, the Extrusion Division of Auburn Button Works in Auburn, New York, compounds and blends a wide variety of special vinyl plastic mixtures for its many customers. Thorough mixing and intensive kneading of the materials is necessary to insure a uniform blend with high tensile strength, good surface quality, retention of heat and light stability and other characteristics important in the finished extrusion. To obtain these characteristics, Auburn employs a specially designed Size 14 BAKER PERKINS JNM2 Universal Mixer with a working capacity of 50 gallons and a total capacity of 75 gallons. This machine is equipped with a trough shell of #304 stainless steel and is jacketed for 80 lbs. steam pressure. It has cast sigma blades with dispersion faces, cored for steam, and is driven by a 20 h.p., 900 rpm. motor.

BAKER PERKINS Universal Mixers are adaptable to virtually every mixing and kneading operation from very light to heavy duty, handling mixtures ranging in consistency from dry powders to stiff plastic masses. For complete information about Universal Mixers and other B-P equipment for the chemical processing industries, consult a BAKER PERKINS sales engineer or write us today.

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BAKER PERKINS INC.

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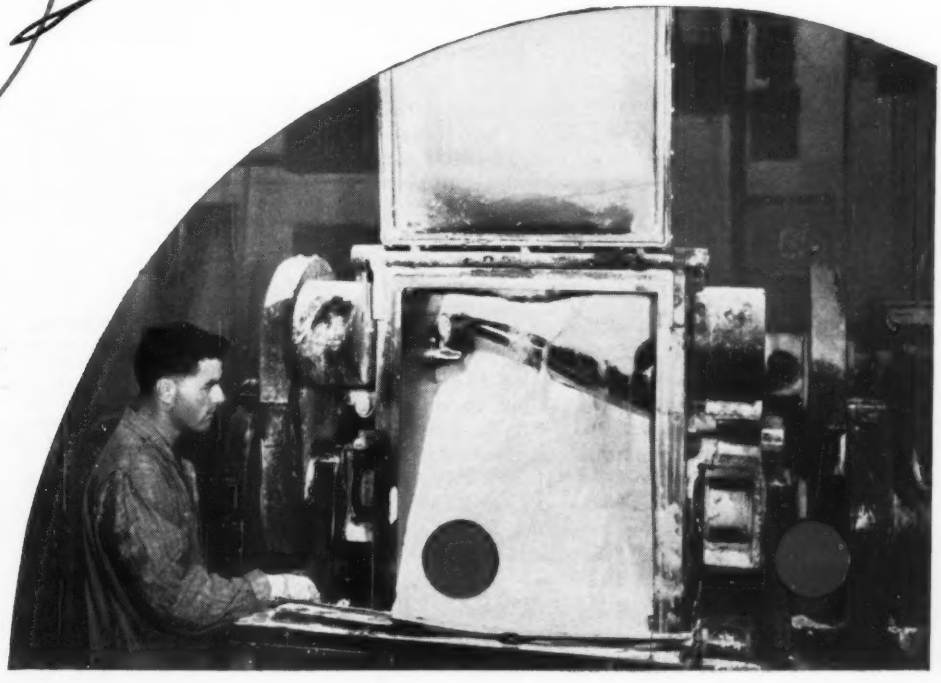
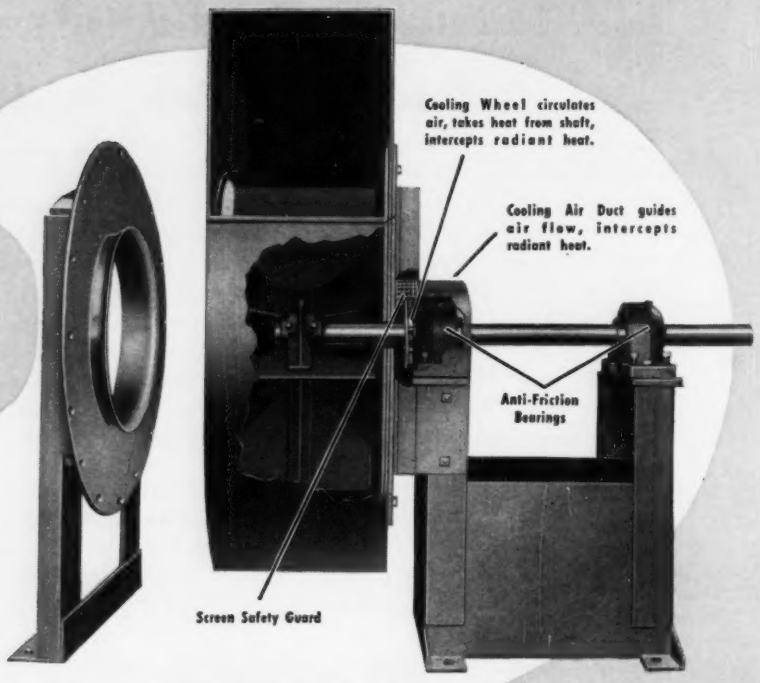


WANT TROUBLE-FREE
high temperature air handling?


Cooling Wheel circulates air, takes heat from shaft, intercepts radiant heat.
Cooling Air Duct guides air flow, intercepts radiant heat.
Anti-Friction Bearings
Screen Safety Guard

New Clarage Type XL Fan shown in "opened up" view is typical of the sizes which provide universal discharge.

MONEY-SAVING SOLUTION:

Clarage's new Type XL Fans equipped with AIR Cooled Bearings!

FOR TEMPERATURES UP TO 750° F., here's a simple, dependable, inexpensive feature available on standard Clarage fans. Costlier water cooled bearings NOT required. By all means, on your next "hot" job consult the Clarage sales engineer about this money-saving optional feature.

The new Clarage Type XL Fan — with its advanced design — offers many other important advantages in industrial air and material handling.

Learn about the high efficiency, rugged construction, and in-the-field adaptability of this exceptional fan equipment by requesting Bulletin 702. CLARAGE FAN COMPANY, Kalamazoo, Michigan.

NOTE: For heavier-duty service or temperatures above 750° F., this and other types of Clarage fans can be provided with water cooled bearings.

You can Rely on...

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Headquarters for Air Handling and Conditioning Equipment

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New Plant now in production taps natural source of sodium sulfate

West End Chemical Company now is producing Salt Cake and Anhydrous Sodium Sulfate at the rate of approximately 50,000 tons annually. These new products maintain the *premium quality* which has characterized West End Soda Ash and Borax for over 30 years. We proudly add Salt Cake and Anhydrous Sodium Sulfate to the list of industrial chemicals carrying the well-known West End brand.

WEST END
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Practical service training at Honeywell's school . . .

makes your instrument men more valuable

Your instrument maintenance men can get a real education in the most up-to-date methods for servicing instruments, at Honeywell's Training School. Any organization which uses Honeywell instruments can send maintenance personnel to this school. Tuition costs you nothing, for this school is maintained as a "plus-value" service to Honeywell customers.

Thousands of technicians have either started or augmented their instrument knowledge here. A variety of courses is available, to fit men for the particular kind of maintenance problems they may encounter in their specific jobs. The comprehensive course . . . one of the most complete and intensive offered anywhere . . . covers about thirteen weeks. Other courses cover five weeks and less, to offer condensed instruction of either a basic or "refresher" nature to men who can't be spared for extended periods.

There's nothing academic about this school. The emphasis is placed on practical knowledge. Theory through lectures and textbook study is liberally supplemented by laboratory sessions and actual bench work on all types of instruments and related equipment.

One caution: classes have to be limited to assure thorough attention to all students, so make reservations in advance. Your local Honeywell office will be glad to make arrangements. Call today . . . it's as near as your phone.

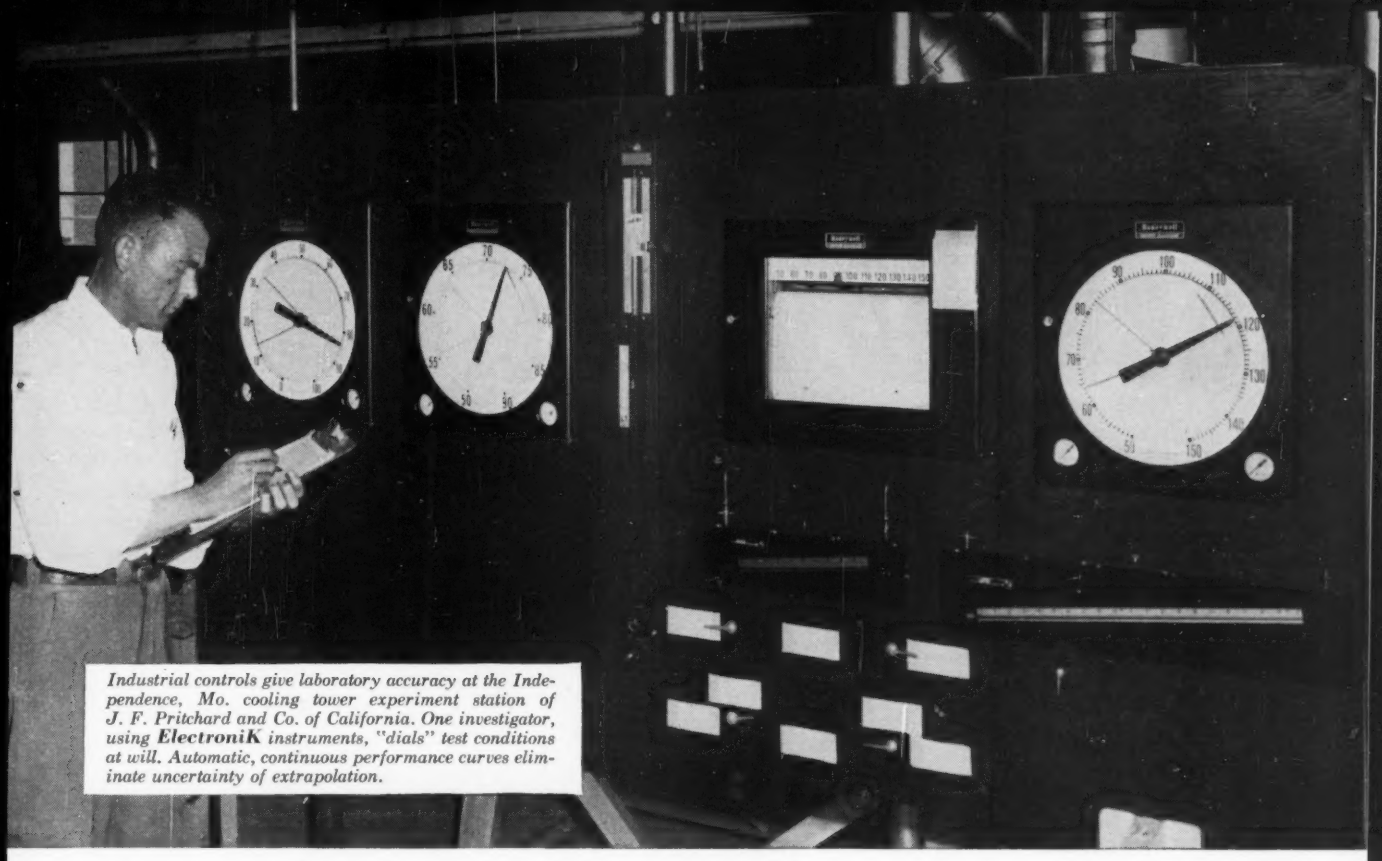
Versatile

ElectroniK

instruments

increase speed,

Experimental cooling tower stands 50 feet high. Tower can be used for any amount of deck filling from ground to maximum height to determine heat transfer efficiency and pressure drop.



Industrial controls give laboratory accuracy at the Independence, Mo. cooling tower experiment station of J. F. Pritchard and Co. of California. One investigator, using ***ElectroniK*** *instruments, "dials" test conditions at will. Automatic, continuous performance curves eliminate uncertainty of extrapolation.*

accuracy of cooling tower research

TEST SPEED more than doubled! Test data accurate within 2%! Test versatility expanded over a wide range! Test costs cut in half! *ElectroniK* instruments have revolutionized this cooling tower research.

From advanced, detailed studies of actual performance, engineers of J. F. Pritchard and Co., Kansas City, Mo. hope to devise formulas for *predicting* the performance of all types of deck filling, under all conditions of use. In these laboratory tests, all the major variables, including incoming air, are under automatic control. Investigators can "dial" test conditions at will, accelerating the research program considerably.

Two *ElectroniK* circular chart controllers maintain wet and dry bulb temperatures of incoming air within 0.2 F of test requirements. Another *ElectroniK* instrument controls water temperature with the same accuracy. An *ElectroniK* strip-chart recorder automatically and continuously compiles a detailed record of the six temperature variables that affect cooling tower performance. It also doubles as an "equilibrium" recorder to show when a test is completed.

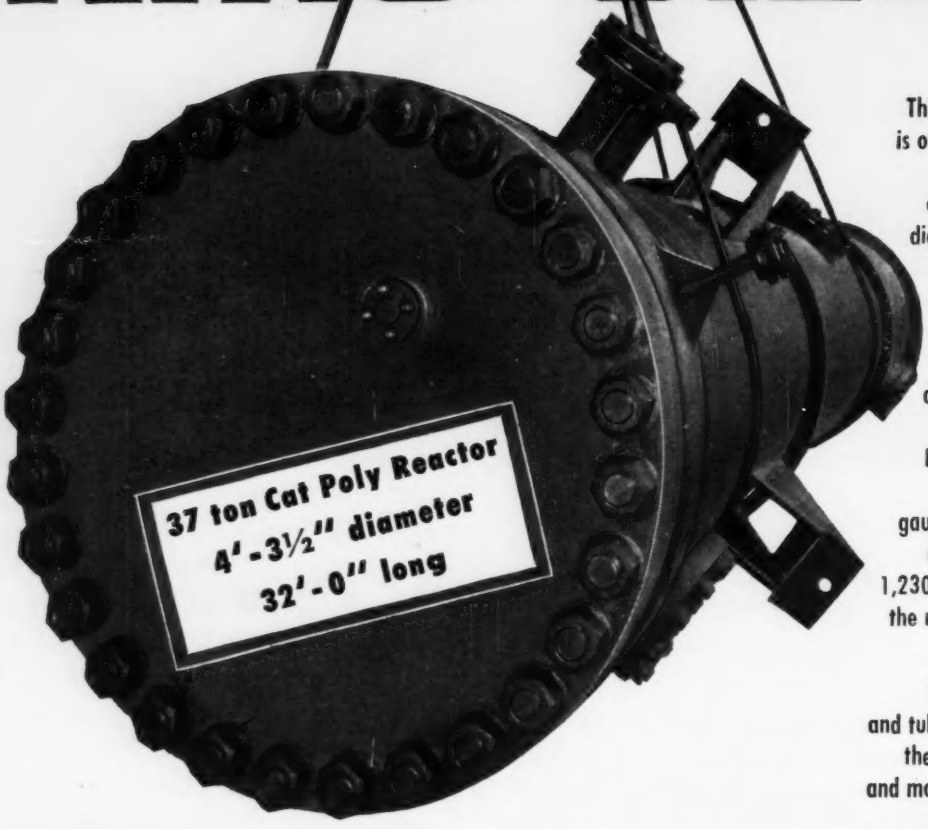
Your nearby Honeywell sales engineer will be glad to discuss *ElectroniK* applications—research and processing—in your operation. Give him a call . . . he's as near as your phone.

MINNEAPOLIS-HONEYWELL REGULATOR CO., *Industrial Division*, Wayne and Windrim Avenues, Philadelphia 44, Pa.—in Canada, Toronto 17, Ontario.

● **REFERENCE DATA: Write for reprint of article—3rd Quarter Issue, "INSTRUMENTATION."**

MINNEAPOLIS
Honeywell
BROWN INSTRUMENTS
First in Controls

KING SIZE



This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-3½" in diameter by 32'-0" long and has a 1³⁄₁₆" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 2¾" diameter by 15¼" long having nuts 4¼" across the flats. Into the 5¾" thick tube sheets 190 tubes, 2½" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

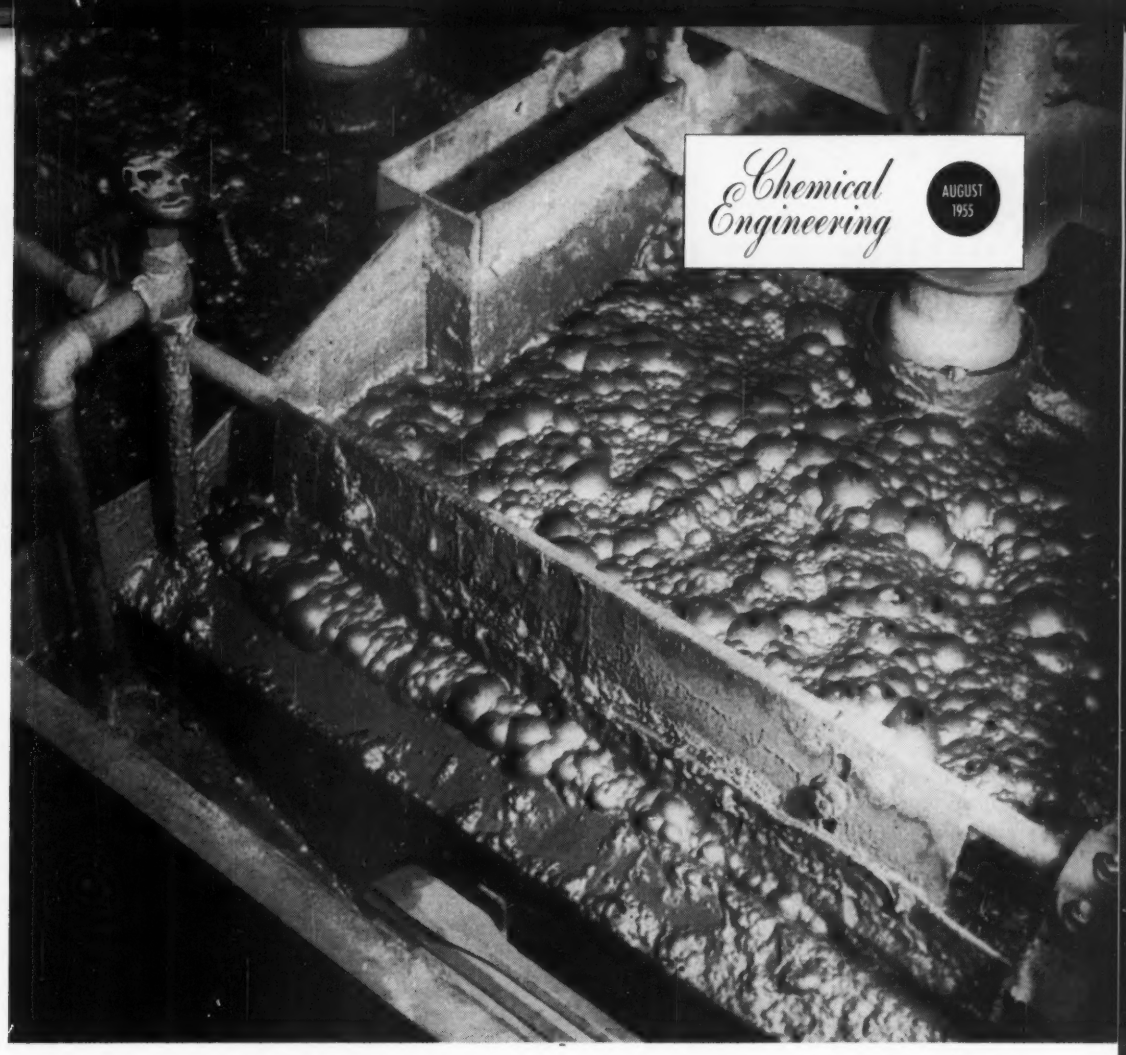
Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

Reactors ...by Vogt

A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.

HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

BRANCH OFFICES: NEW YORK, CHICAGO, CLEVELAND, DALLAS, PHILADELPHIA, ST. LOUIS, CHARLESTON, W. VA.



Courtesy of Denver Equipment Co.

Solids Concentration

CURRENT PRACTICES and trends in processing raw materials surveyed and evaluated.

FOR producers and for users of raw materials. Also for engineers faced with problems of separating solid mixtures.

BECAUSE leaner raw materials are now forcing industry to apply more intensive upgrading techniques.

Solids Concentration

Key Properties of Solids

Separation Processes

Sorting

Gravity Processes

Magnetic Separation

Electrostatic Separation

Flotation

By **NATHANIEL ARBITER** who is Associate Professor of Mineral Engineering at Columbia University. Professor Arbiter combines teaching with consulting for firms such as Sinclair Refining, Foote Mineral and Miami Copper.

As a comparative newcomer in engineering ranks, chemical engineering has drawn heavily from knowhow existing in older branches of the profession. Mineral engineering, for instance, produced many of the slurry processing techniques adapted later by the chemical and processing industries.

Now that chemical engineering has matured many of its procedures are flowing back into the minerals field to become part of its modern processing. And with them are going chemical engineers.

For chemical engineers engaged in mineral operations in chemical or mining companies one fact should remain clear. Physical processes for separation and concentration of ore values are inherently cheaper than any other means, provided they can do the job. Too, for non-mineral processes they frequently offer real gains.

COMPLETES THE PACKAGE

In June, we presented a 64-page critical survey dealing extensively with the solids-liquid separation operations. Equipment and operations discussed were those acting primarily to separate a solid more or less completely from a liquid.

Here we present as a sequel to the June report a review of techniques and equipment which separate mixtures of solids to obtain concentration of the valued constituent, or fractionate into desired size ranges.

Together these reports provide a comprehensive round up of separating techniques.—Ed.

Historically, the trend in exploitation of ore deposits has involved treating progressively lower-grade materials. Initially, for any one type of ore, mine output was either directly saleable or sufficiently high grade to be smelted directly.

As this premium material became exhausted, lower-grade deposits that required concentration came into use. In such cases, gravity separation methods applicable at coarser sizes were employed.

Finally, with the lowest grade ores, which often are finally disseminated, either flotation or magnetic separation became mandatory provided recovery could be justified economically.

This sequence is illustrated clearly by the history of iron ores. Prior to World War II, blast furnaces were supplied primarily with ore shipped directly from the mine. But over the past twenty years reserves of such ore have diminished, forcing leaner ores to be upgraded by gravity processes.

Finally, during the past few years processes have been developed and plants constructed to treat still lower-grade ores by grinding and magnetic separation or flotation.

Varying stages in this sequence are seen in the history of other ores. For example, aluminum ores are still mined at a sufficiently high grade to permit direct Bayer processing. On the other hand, American copper ores have been ground and treated by flotation before refining for over forty years.

Key Properties of Solids

When a mixture of two or more solid components of different mineralogical or chemical composition must be separated, two conditions should prevail:

- Individual particles of the constituents should be within the size range where they are essentially pure or this condition should be readily attainable by size reduction.
- The components to be separated must differ in some physical property or in surface chemistry.

With these conditions satisfied the effectiveness of separation can be measured by:

- Purity of one or more of the separate fractions (concentrate grade or assay.
- The proportion of a component of the original mixture which is present in the concentrate (recovery or extraction).

Obviously, the boundary conditions for physical separation are 100% recovery of the original mixture which represents no physical selectivity, and 100% recovery of pure concentrate which represents maximum selectivity. The extent to which the original components of the mixture interlock and differ in physical properties will govern the selectivity in any actual case.

Where the components of the mixture are for the most part separate particles it is possible frequently to obtain high-purity concentrates. For example, sulfide concentrates of lead and zinc ores can approach 95% purity in the respective minerals by either gravity or flotation processes. Molybdenite of over 99% purity results from flotation; zircon gravity and flotation reaches over 99% purity.

However, in ores where the minerals are fine-grained and associated intimately it may be impractical to grind down to complete liberation. In such cases the grade of concentrate will be determined by comparative economics and may be far less than theoretical.

How the components are associated also can govern recoveries. It may be mandatory to waste some of a valuable component because the cost of grinding to complete liberation exceeds the additional values that are gained. Or a high-purity specification may force all mixed grains to be eliminated from the concentrate.

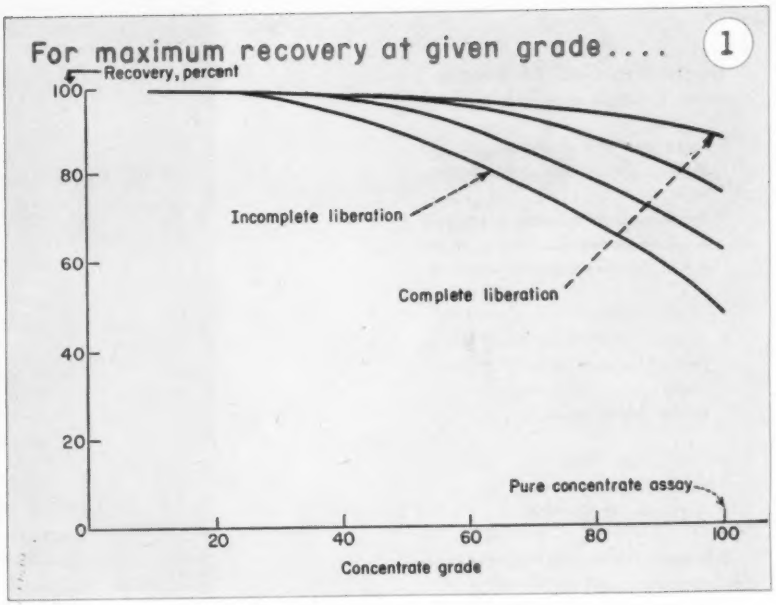
How recovery varies with concentrate grade is shown in Fig. 1. The region of high-recovery, low-grade concentrate is determined by intensive but less selective separation conditions with both mixed components and waste present in the concentrate.

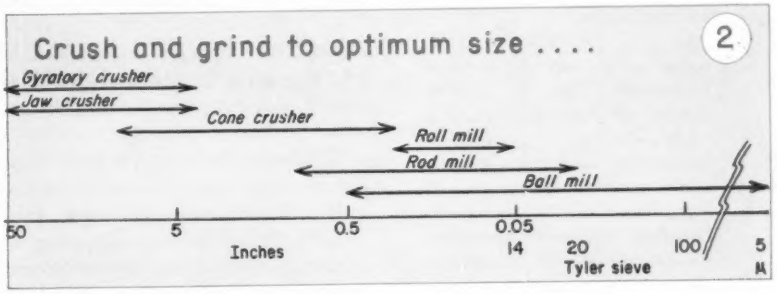
As the separation process becomes less intense first waste and then mixed-component particles are removed progressively from the concentrate. But this upgrading of concentrate purity is done at the expense of discarding some valuable component with the reject material.

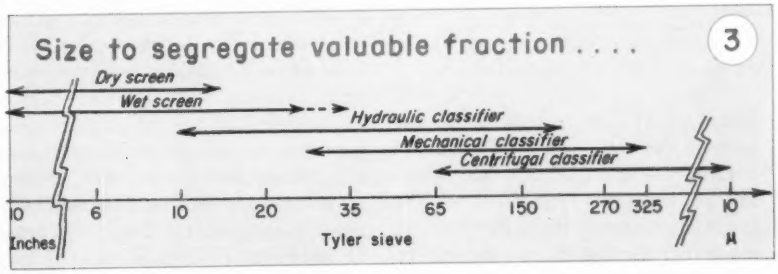
Altering the extent of liberation of values by varying the degree of grinding will usually change the shape of the curve in Fig. 1.

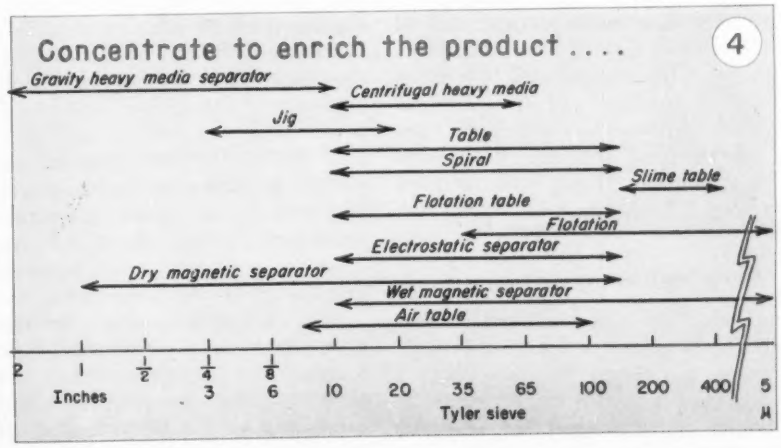
Efficiency of separation in physical ore-treating methods is dominated by the size of the component grains in the original material. For this factor dictates the size range to which the ore must be crushed and ground to liberate the components as required.

This size range and the value of the mineral or minerals determine whether crushing and grinding costs are within a range to permit the ore to be treated economically. Also, size range, Fig. 4 will determine choice of separation process while the extent of









Upgrading Can Be Simple —or Complex—Table I

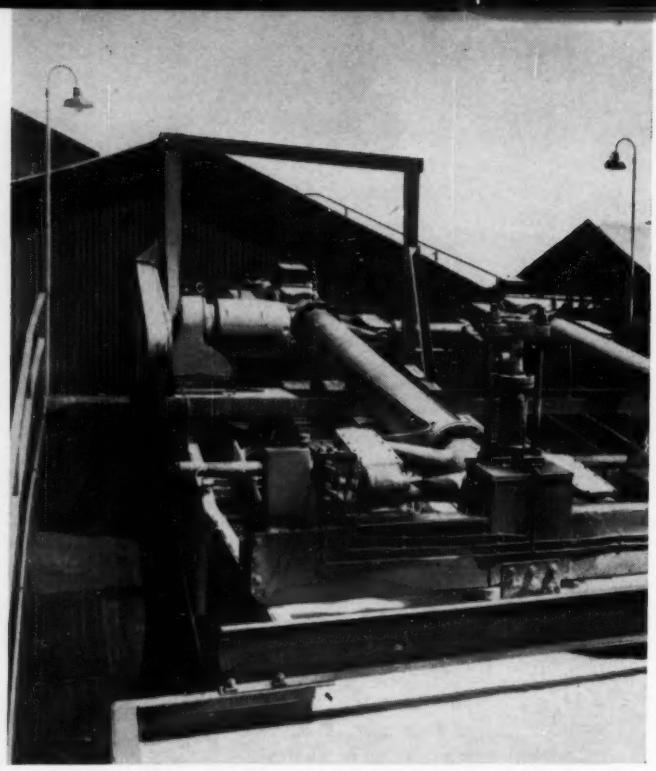
1. Many iron and aluminum ores require no physical concentration.
2. Beach sands as a source of titanium or zirconium minerals need no crushing or grinding prior to concentration.
3. Apatite is recovered from Florida pebble-phosphate ores by scrubbing mildly prior to concentrating by gravity and flotation.
4. Copper ores from the Southwest must be ground through 35 or 48 mesh prior to flotation.
5. Mesabi taconites eventually must be ground to 100 mesh before producing iron concentrates by magnetic separation.
6. Nickel sulfide may be recovered from Sudbury ores by crushing, grinding and flotation to recover a mixed nickel-copper-iron sulfide concentrate. Concentrate is matte smelted and cooled slowly to produce a coarse, crystalline nickel sulfide phase. The matte is crushed, ground and floated to produce nickel-sulfide concentrate.

liberation by size reduction will determine the sharpness of separation.

Ore grade is a further consideration in ore treatment problems. If the grade is sufficiently high, direct smelting or marketing of the raw ore may be possible. At the other extreme, the market value of the valuable mineral constituent may not be sufficient to warrant the costs of mining, concentration and transportation. Between these extremes are found the ores that are being upgraded by concentration processes. Table I illustrates this range of conditions.

Classification

Solids can be concentrated by classifying to isolate particles within a desired size range. In many cases a classified fraction is treated further by other concentrating techniques. Since classification frequently precedes further upgrading treatment we shall discuss it first before proceeding to the other methods.



RAKE classifier at Coronet Phosphate Co.'s Tenoroc mine handles 235

The separation of solids from fluids has already been considered in detail in *Chemical Engineering*, June 1955, p. 175. The use of gravitation or centrifugal settling for this purpose is merely one aspect of classification, i.e., one in which feed rates and machine sizes are such that the residence time allows all or substantially all particles to settle.

If either feed rates or machine sizes are changed to permit shorter residence time, then the overflow, instead of being relatively free of solids, will contain all particles finer than some limiting size. If solids of differing specific gravity are present, then their limiting sizes will differ.

Classifiers in current use are of three main types: (1) mechanical (2) hydraulic, (3) centrifugal.

Mechanical Classifiers

This machine is used primarily in closed circuit wet grinding for size control. To a lesser extent it is applied to dewatering and washing granular solids, and to desliming.

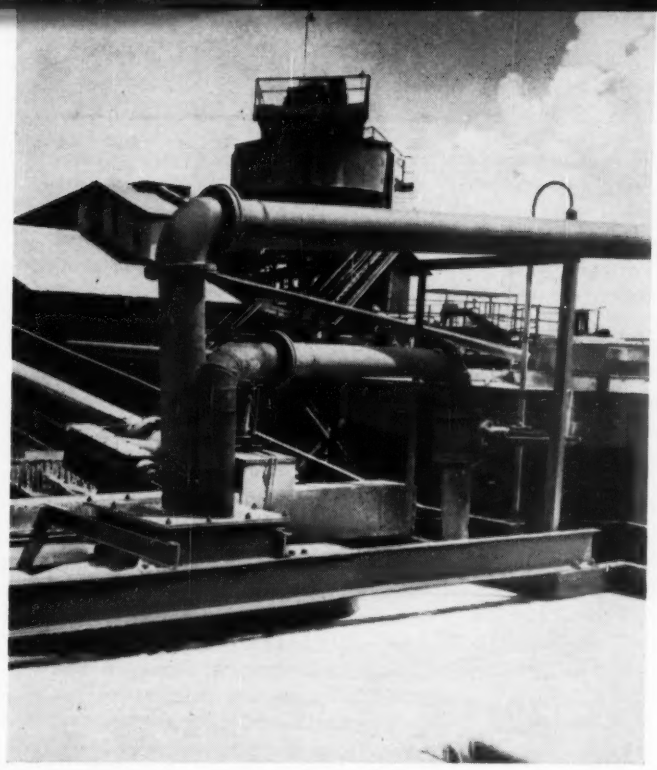
The machine comprises a settling tank, rectangular or cylindrical, on an incline. The finer product, together with the greater proportion of water, overflows a weir at the lower end of the tank. The coarser product, after it has settled to the tank bottom, is moved to the upper end of the tank by one of four mechanical devices: rake, spiral, drag, or drum with internal spiral.

Mechanical classifiers separate in the range from 28 to 200 mesh. For finer separations a bowl combined with a rake has been used, although cyclone classifiers (*Chemical Engineering*, June 1955, p. 234) are now taking over this field.

Classifier overflow capacities range from 6 tons per hr. per ft. at 28 mesh to 1 tph. at 200 mesh, for solids with 2.7 specific gravity. Sand raking capacities range from 15 tons per hr. at 28 mesh to 6 tons per hr. at 200 mesh.

Control of mesh of separation is primarily by control of percent solids in overflow as follows: 28-mesh —33%, 48-mesh—22%, 100-mesh—15%, 200-mesh—8%. Slope of tank bottom controls pool area and hence mesh of separation to a minor extent. More directly it affects moisture content of sand.

Slope is limited by angle of repose of sand. In general, minimum moisture in sand requires higher slopes; maximum cleanliness of sand (freedom from trapped fines) requires lower slopes. Range of slopes is 2 to 3½ in. per ft. for rakes, 3 to 4 in. for spirals; up to 6 in. for drags.



tons per hour of dry solids to recover plus 150 mesh. (Dorr-Oliver)

Height of the overflow weirs is variable in some cases; raising the weir permits finer separation and lowering the opposite effect.

In addition to particle size and density of minerals, the state of flocculation of the micron size material in the ore can affect classifier operations. This is indirect in the sense that heavily flocculated fines can mechanically trap fine sands and reduce the settling velocity of coarse sands. The result is the production of a coarser overflow with other operating variables constant. The remedy is dispersion of the pulp.

Mechanical classifiers by permitting greater efficiency in wet grinding circuits contributed to the application of separation processes to finely disseminated ores. In closed grinding circuits they make possible large increases in capacity when grinding to a specified size and reduce overgrinding by the same token. In comparison with open circuit grinding to the same upper size limit of ground product the closed circuit, with circulating loads up to 5 or 6 times the weight of new feed, produces an over-all product of coarser average size.

Centrifugal Classifiers

The centrifugal classifier, like the mechanical classifier, makes a two-product size separation. However, instead of depending on gravity to obtain particle settling velocities, it supplies a centrifugal field.

Two advantages follow: (1) the residence times and consequently machine sizes for a particular size split are markedly reduced, (2) practical separations become possible down to at least 10 microns.

Two types of centrifugal machines have been applied to ore separation. The mechanically rotated cylindrical shell with an internal spiral screw to remove sands has had limited applications for fine classification and desliming. The wet cyclone, fed by pump or with an internal impeller, is now being used extensively for classification from about 65-mesh down to 10 microns or finer.

The latter machine, because of its low first cost, small floor space and ease of control, is making serious inroads into the field formerly dominated by mechanical classifiers in closed circuit grinding. It is also providing a new and powerful tool for removing near colloidal fines from flotation feeds. For the latter application, the cyclone may prove to be one of the most important developments in recent years.

A more detailed description of the centrifugal classifiers can be found in *Chemical Engineering*, June 1955, pp. 217, 234.

Pinpointing the Terms

Feed or head
Material to be concentrated.

Concentrate
Enriched product of concentration.

Tailing
Discard of concentration operation.

Gangue
Worthless minerals in ore.

Dissemination
Distribution of mineral grain size.

Concentration criterion
Numerical indication of gravity separation possibility.

Recovery or extraction
Percentage of feed values found in concentrate.

Ratio of concentration
Tons of feed treated to produce 1 ton of concentrate.

Concentration
Separation of mineral mixtures by physical means.

Classification
Separation of mineral mixture by size differences.

Middling
Intermediate concentration product having mixed grains.

Flotation collector
Organic acid or base adsorbed by a mineral, permits adhesion of particle to air bubble.

Flotation activator
Inorganic ion adsorbed by mineral, permits or enhances collector adsorption.

Flotation depressant
Inorganic or organic ion, molecule or colloid adsorbed by mineral, decreases or prevents collector adsorption.

Conditioning
Any regent treatment of flotation feed prior to flotation.

Hydraulic Classifiers

In the late 19th and early 20th century, the hydraulic classifier was a dominant machine in ore concentrating plants. In contrast, recent visits to at least a dozen plants disclosed only one such classifier in operation. The change is due entirely to the lessened importance of gravity concentration and to the fact that the hydraulic classifier was primarily used to prepare short range feeds for subsequent gravity separation by jigs and shaking tables.

Present day machines comprise a series of settling chambers usually of

increasing volume from feed to discharge end. Hydraulic water is added to each chamber from below at adjustable rates. Feed is added to the first chamber where the coarsest fraction is removed while the overflow is fractionated progressively in subsequent chambers.

Within any one chamber a fluidized bed is maintained under the prevailing rising water velocity. Particles unstable with respect to bed conditions are either carried up and out of the chamber or penetrate through the bed and accumulate. An automatic discharge mechanism actuated by pressure build up permits intermittent discharge of accumulated underflow product. Commercial machines have been made with from 3 to 14 pockets.

Current applications, as indicated, are not extensive. These classifiers can be found principally in those lead-zinc operations using jigs and tables for coarse mineral recovery, in coal washeries, in phosphate plants, preparing feed for agglomerate tabling, and in tungsten and tin recovery.

The machines require little supervision; capacities are high averaging 44 tons per day per ft. for a limited number of installations. Water requirements are variable, ranging from 200 to 2,000 gal. circulated per ton treated.

In addition to the major types of classifiers noted, any number of conical and cylindrical vessels with various means of controlling and recovering underflow have been devised for the same purpose. (see Taggart, "Handbook of Mineral Dressing," 2nd ed. Sect. 8).

Properties Set Selective Force—Table II

Property	Force	Operation
Color, reflectivity, shape	Manual	Handpicking
Transparency	Mechanical deflection	Optical picking
Radioactivity	Mechanical deflection	Radioactive picking
Magnetic permeability	Magnetic	Magnetic separation
Conductivity	Electrostatic	Electrostatic separation
Specific gravity, size, shape	Gravity, fluid drag	Gravity separation
Surface wettability, size, specific gravity	Gravity, fluid drag	Flotation

How to Apply Solids-Concentrating Techniques—Table III

Most of the separation techniques described are potentially applicable to any solids regardless of origin. For a particular problem, you can use the following approach.

Wet Processing

A. If one solid is strongly magnetic, consider wet magnetic separation down to micron sizes.
B. If concentration criterion is greater than 1.1 or more, see Table VI, consider heavy medium process for particle sizes coarser than 10 mesh and heavy medium cyclone process for particles between ¼ in. and 65 mesh.
C. If concentration criterion is greater than 1.25 and particle size range is between ½ in. and 200 mesh, consider jigs, tables or cyclones.
D. If specific gravities are too close for gravity separation and particle size range is 10 to 100 mesh, consider agglomerate tabling. If particle size range is finer than 35 mesh, consider froth flotation.
E. If particle size range is finer than 100 mesh, regardless of specific gravity differences, consider flotation. Flotation is generally possible wherever solids differ in chemical composition, or with the same composition, if they differ in crystal structure.

Non-Aqueous Processing

A. If solids cannot be processed in water and differ in specific gravity, consider:
   1. Air tabling, size range ⅜ in. to 100 mesh.
   2. Air-fluidized heavy medium, 2-in. to 10 mesh. Little used except on coal.
   3. Organic heavy liquids. No practice except on coal. Theoretically capable of making separations at small gravity differences using gravity alone at sizes above 10-20 mesh, and centrifugal force for finer sizes. Should not be considered except for high-value materials.
B. If solids are too close in specific gravity (0.1-0.2 units) consider electrostatic separation. Prediction not possible; tests by equipment manufacturers necessary.
C. If one solid is weakly or strongly magnetic, consider dry magnetic separation down to 200 mesh.

Basic Separating Concept

Once a component(s) of the ore is in a liberated state, either naturally or through size reduction, the mixture then can be separated by passing it through a choice of machines where a selective force field exists. The field acts on the particles of one component and makes them move away from the other particles in the mixture. Hence, two streams leave the machine; a product stream and a reject stream.

Original feed and the unaffected components usually are moved through the machine by gravity or fluid drag. The force acting upon the selected component is chosen on the basis of differences existing in the properties of the solid components, as shown in Table II.

It is apparent from the tabulations that the physical separation processes are based on a limited number of available properties.

For instance the picking processes have very limited application. Magnetic separation is not generally useful because of the small number of magnetic materials. Electrostatic separation is limited to high-value products because operating cost is relatively high and feed must be dry and within a fairly narrow size range.

Thus the separation of ore minerals relies principally on the gravity processes including flotation.

Sorting

Sorting to separate individual particles is used on coarse mixtures.

Hand Sorting

Despite the fact that hand sorting is a primitive concentrating method, still it is used today under combinations of special circumstances:

• Occurrence of either high-grade or very low-grade component above a minimum size of about 2 in.

• Differences easily distinguished visually between valuable and waste material.

• Favorable labor rates.

• Difficulties in separating by gravity at coarse sizes.

Ores being concentrated today by hand sorting include chrome ores, manganese ores, coal, graphite, mica, gems, and, with increasing rarity, sulfide ores.

Mechanical Sorting

A very limited number of mechanical devices have been developed for sorting fairly coarse material. These consist of a conveyer to move the solid particles slowly past a sensing device which responds to some property of either valuable or waste material. On an appropriate signal from a particle the sensing device actuates a mechanical arm or deflector which removes the piece from the belt.

For uranium or radium minerals, the Lapoint picker reacts to radioactivity emitted by the particles. A picker for optical fluorspar passes a light beam through each piece and accepts or rejects according to the transmission.

Mechanical sorting devices will always have limited capacity since they can scan only one particle at a time. They are limited to fairly coarse solids. On the other hand, they are relatively inexpensive to operate and usually replace labor.

Further extension of this concentrating method is blocked by the need for processing lower grade ores with finer mineralization. Too, there is a very limited number of physical properties which can serve as basis for selection. In an attempt to circumvent the latter limitation, radioactivity has been induced artificially to sort beryl mechanically on a laboratory scale.

Chemical Raw Materials Needing Solids Concentration—Table IV

Material	Concentrating Treatment
Barium minerals	Handpicking, jigging, tabling, flotation.
Clay	Tabling, jigging, flotation.
Coal	All gravity processes, flotation.
Cryolite	Handpicking, magnetic separation, jigging, tabling.
Feldspar	Handpicking, magnetic separation, flotation.
Fluorspar	Heavy medium, jigging, flotation.
Glass sand	Magnet separation, flotation.
Kyanite	Air tabling, magnetic separation, flotation.
Limestone (for cement)	Flotation.
Mica (fines)	Jigging, spirals, flotation.
Phosphate rock	Handpicking, spirals, flotation.
Potash (muriate)	Table flotation, flotation.
Sulfur (low grade ores)	Autoclaving & flotation.
Titanium minerals	Spirals, flotation.

Significance of Concentration Criterion—Table V

Criterion	Significance
>2.5	Separation effective down to about 200 mesh.
2.5-1.75	Separation effective to 100 mesh.
1.75-1.50	Separation possible to 10 mesh, but difficult.
1.50-1.25	Separation possible to ¼ in., but difficult.
<1.25	Relative processes inapplicable but absolute processes possible.*

*Commercial separations using heavy medium have been made with specific gravity difference as low as 0.2.

Gravity Processes

Gravity processes literally are as old as the hills. Without benefit of the human touch they are responsible for the natural concentration of heavy minerals such as gold and cassiterite in placer deposits. Prehistoric man probably found his first gold in stream beds and in the search for more developed the arts of panning and possibly of jigging.

Modern separation processes based on differences in specific gravity between minerals fall into two categories: relative and absolute.

Relative processes depend on differences in settling velocities of particles in a fluid, usually water.

Absolute processes require a fluid with a specific gravity between those of the components to be separated so that the lighter will float and the heavier sink. Both types depend not only on specific gravity of the particle but also on size and shape.

In all gravity processes the possibility of separating two components having different specific gravities requires that gravitational force act on the particles. In turn, this depends on the effective mass of the particle which is the actual mass of the particle less the buoyancy correction.

A separation criterion can be expressed arbitrarily as $(\rho_1 - \rho_3)/(\rho_2 - \rho_3)$ where ρ is specific gravity and the subscripts 1 and 2 denote the two components and 3 the fluid which usually is water. The value of this ratio determines the limit of particle fineness at which separation is effective. Table V shows a listing of concentrating criterion.

Relative Gravity Machines

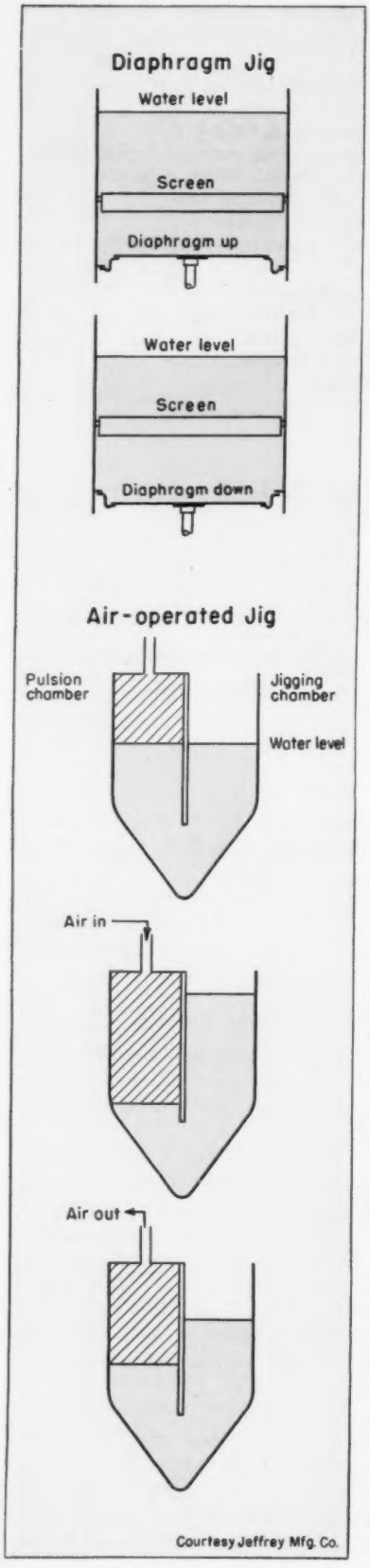
Two principal considerations govern the selection of a relative gravity machine and the effectiveness of separation:

• The size range to which the ore must be crushed or ground to substantially liberate the mineral grains.

• Difference in specific gravity between the minerals to be separated.

Fig. 4 indicates the size ranges over which all the important concentrating processes and machines, including gravity processes, are effective.

Until the late 19th century ore concentration depended solely upon relative gravity processes. A large variety of mechanical devices had been developed, all based on differences in particle settling velocities.



Many of these now are obsolete. Those remaining are the jig, the shaking table and the spiral concentrator. They differ principally in the mechanical methods employed to stratify the mineral according to density and separate the strata obtained.

JIG

The jig is an ancient machine dating back at least to the time of Agricola. Jigging is a wet process employing a horizontal screen or other perforated surface over which the feed flows continuously.

The screen may be oscillated vertically 0.2 to 2 in. at frequencies of 150-300 per min. Or an equivalent effect may be obtained by pulsing water intermittently through a fixed screen. Pulsating is produced by mechanical, hydraulic or pneumatic devices.

The jig separates by alternately dilating and contracting the particle bed. When the bed contracts the dense particles accelerate downward more rapidly than the lighter ones. A stratum of dense particles forms immediately above the screen. On top of this stratum is formed a layer of middling particles which are heterogeneous particles containing both dense and light phases. The uppermost layer is composed of the light mineral fraction.

Within each layer, particles separate further according to size. After the coarse particles make contact during contraction the fines flow down through the voids to concentrate in the lower portion of the layer.

One compartment in a jig will make only two products. Consequently, normal operation for a two mineral separation involves two or more compartments to produce concentrate, tailing and one or more intermediate products.

Jig operation is controlled by varying feed rate, water rate, depth of bed and product layer, and stroke. Coarse feeds require longer and slower strokes.

In their heyday during the 19th and early 20th century, jigs were used to treat feed sizes ranging from 3 to 48 mesh. The development of shaking tables restricted jig applications generally to plus 10 mesh material. More recently the heavy media processes have taken over separations down to about ½ in.

Within the narrow range from about ½ in. to 10 or 14 mesh, the jig is still a useful machine. Capacities range from 0.1 to 1 ton per hr. per sq. ft. of screen area, increasing with feed size. Power varies from 0.2 to 2 hp.-hr. per ton and also increases with feed size. Water circulation is approximately 5 tons per ton of ore.

In recent years jigs have been used mainly for recovering gold on placer dredges, in grinding circuits treating gold ores, for recovering coarse lead and zinc sulfide concentrates prior to flotation, for recovering coarse fluorite and garnet, and for concentrating iron and manganese ores.

SHAKING TABLE

The shaking table is of more recent origin than the jig, dating to about the turn of the century. It has a rectangular or rhombohedral deck from 4 to 6 ft. wide and 12 to 15 ft. long. The deck surface usually is covered partially or fully with lengthwise riffles running parallel or at a slight angle with the side.

The desk is canted slightly sideways and reciprocates lengthwise. An essential feature of the reciprocating motion is that it accelerates slowly outward then speeds up on the return stroke.

In simple terms, feed introduced at the upper corner of the table is subjected to the shaking action and a crossflow of water along the incline. Light particles are swept by the water across the riffles to a discharge launder running along the lower side. Heavier particles are trapped by the riffles and moved by the shake to the end of the table and discharge.

More specifically, as the feed moves onto the table particle sizes below some lower limit will be carried by the water directly across the deck to discharge. Coarser particles will form a dilated bed between the riffles under the combined action of shaking and eddying of water within the riffles.

Dilation of the bed allows the particles to stratify within the riffles according to specific gravity. Within each stratum coarse particles will lie above fine. Because of the cross flow of water and the tilt of the deck the

uppermost layer of particles consisting of the coarse light mineral will move across the deck.

By contrast, the lowermost layer made of fine heavy mineral is propelled along the deck in a lengthwise direction by the oscillation because it is shielded from the force of the cross flowing water.

What started out as vertical alignment of particles ends up as a horizontal alignment about the corner of the table diagonally opposite the feed inlet. Movement of the middling particles will follow paths between the light coarse and heavy fine solids. Or comparing travel pattern with a fan they will move in the central sectors.

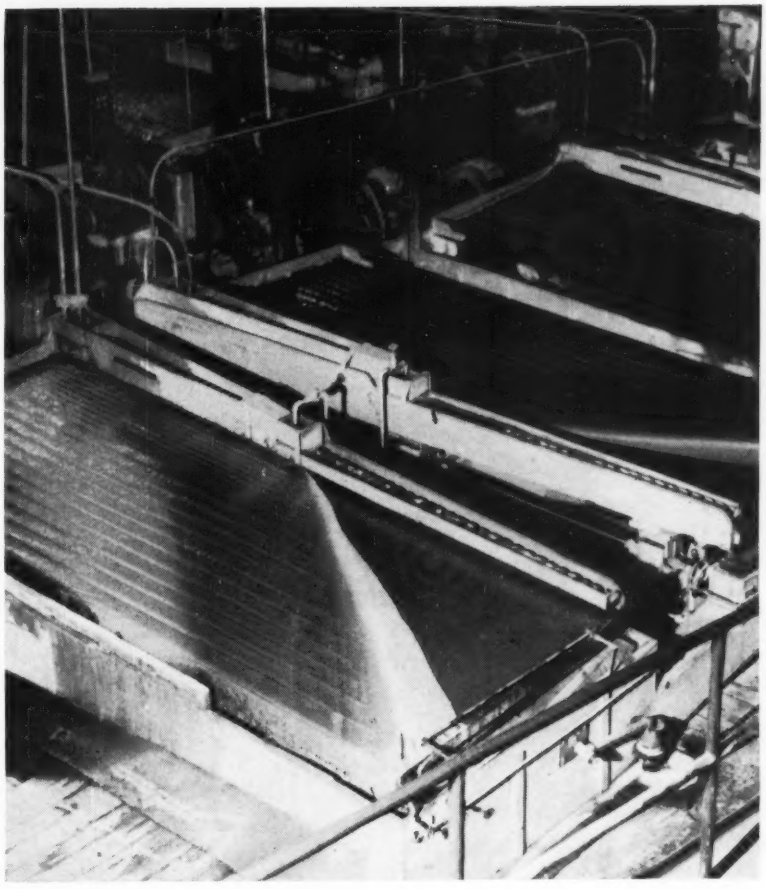
Feed is introduced at about 25% solids; total water requirements for first stage treatment vary from 50 to 350 gal. per ton of solids. Installed power is usually ¾ or 1 hp. per table.

For roughing service on minus 0.1-in. feed, capacities vary from 8 to 10 tons per hour, per deck; for cleaning from 2 to 3 tph. per deck. With classified feed where concentrate, middling and tailing can be made in one operation capacities are 0.5 to 1.0 tph. per table.

The shaking table works most effectively in the size range 8-10 mesh to 100 mesh. Lower limit is extended by a favorable concentration criterion, classified feed and special decks.

Development of the flotation process after 1910 made the table superfluous for sizes finer than 35-48 mesh, except for ores where flotation is difficult. More recently the spiral concentrator which covers the same size range as the table has made serious inroads into this segment of the concentrating field.

Present day use of the shaking table is restricted to more or less special applications. Among these are the cleaning of metallurgical wastes, sand and gravel, coal; limited use concentrating iron ore, ilmenite and chrome; and fairly extensive use on tin ores.

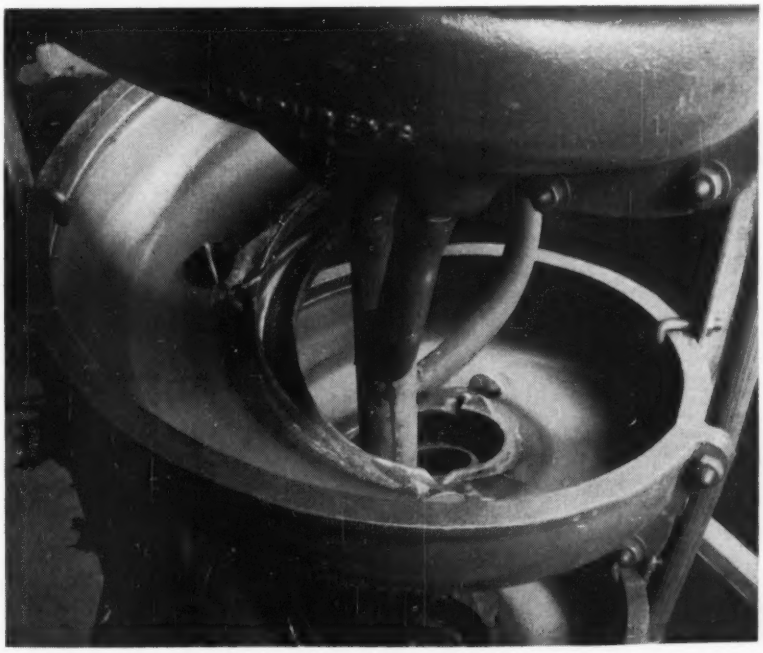


SHAKING tables show riffles and water flow pattern. (Deister Concentrator Co.)

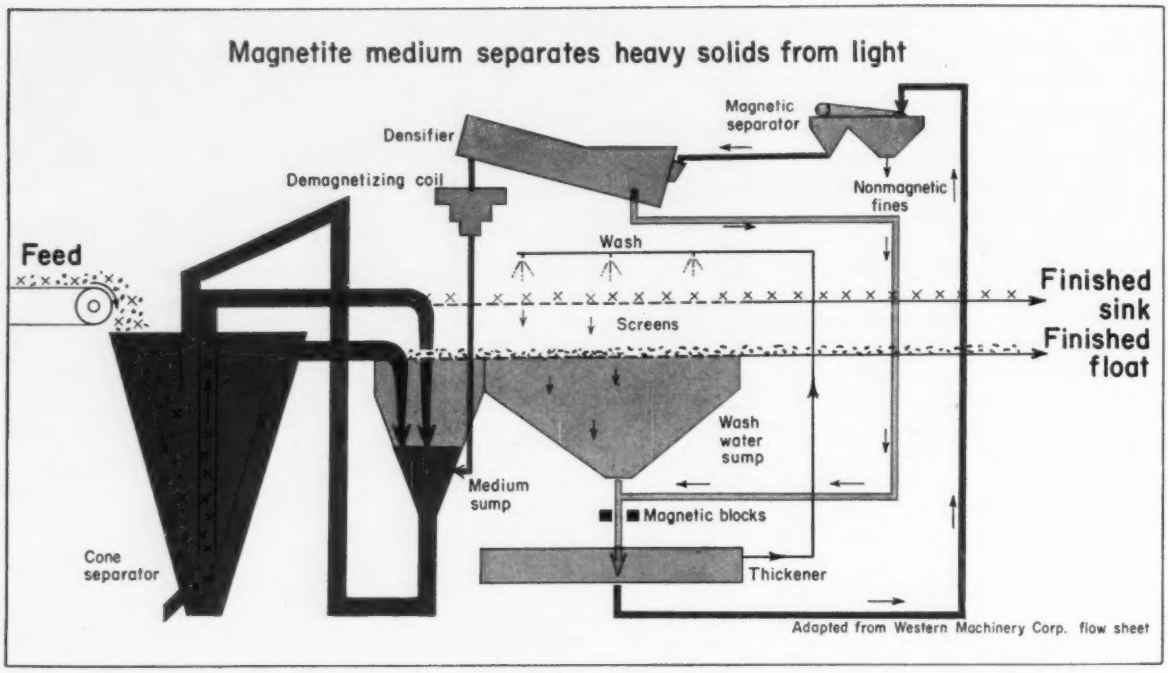
SPIRAL CONCENTRATOR

The spiral concentrator (Humphrey Spiral) has been developed within the last decade. A trough of cast iron or concrete is wound around a vertical axis. Roughly, it looks like a spiral baggage chute.

Outside diameter is 2 ft. For metal-



SPIRAL concentrator with take-off ports for fractions. (Humphreys Investment Co.)



HEAVY media separation process has circuit to split feed on absolute gravity basis and one to recover medium solids.

lic ores there are five turns with 13½ in. pitch; for non-metallics six turns at 10-in. pitch are recommended.

Dilute feed pulp is introduced at the top of the spiral. Maximum size for ores is about 10 mesh, for coal ¼ in. Both specific gravity and particle shape affect concentration. The size range of particles should not exceed four times the separation criterion.

Separation depends upon the heavier particles getting to and remaining in the trough bottom along which several take-off ports are provided. Slower-settling particles are centrifuged toward the outer rim of the trough.

Products from the lower take-off ports normally will be lower grade than those from the upper and can be segregated. Product from the lower end of the trough will be the lighter mineral. Concentrates from the first treatment are given a second pass through 3-turn cleaner spirals.

The spiral is a relatively inexpensive machine with no moving parts and requires little supervision. Although a single spiral has low capacity (up to 1.5 tph.) it occupies little floor space. Hence per unit of floor space, the spiral unit normally will have much more capacity than the shaking table.

Applications for this equipment are still increasing: It is now recovering phosphate sand from pebble phosphate; rutile, zircon and other heavy minerals from beach sands; concentrating non-magnetic iron oxides (hematite and martite).

Absolute Gravity Processes

All the processes described thus far depend on relative differences in particle settling rates due to the combined effects of particle density, size and shape. It is apparent that if a mixture of light and heavy solids is suspended in fluid with an intermediate specific gravity the lighter solid will float and the heavier one sink.

Three types of fluids are possible:

- Solutions of dense inorganic salts in water.
- Dense organic fluids.
- Water suspensions of fine heavy solids.

Salt solutions have had a limited commercial use in separating coal from slate in the range of 1.4-1.5 specific gravity. Pentachloroethane has been tried commercially for the same purpose. However, the only type of system used for treating ore commercially today is the fluidized suspension.

While pentachloroethane was not economical for coal, with a loss of ½-¾ lb. per ton treated, use of organic liquids for more valuable solids should not be overlooked. Acetylene tetrabromide (sp. gr. 2.95) is available at 55¢ per lb.

Two types of fluidized-suspension processes are now in use. The first and earliest depends on gravity alone to provide rising and settling velocities. The second pumps a mixture

From Mine to Absolute-Gravity Concentrate—Table VI

1. Crush raw ore to size range susceptible to treatment, 2 in. to 10 mesh.
2. Screen wet at ⅜ in. to 10 mesh to remove undersize.
3. Add oversize continuously to a vessel containing a suspension of minus 65 mesh solids adjusted to the correct concentration to give the desired apparent specific gravity.
4. Recover float and sink products continuously.
5. Drain products on screens to recover medium.
6. Wash remaining medium from products on screens.
7. Recover, clean and densify medium solids and return continuously to separation vessel.

of suspended medium and ore through a cyclone to increase separation velocities.

The essential elements of the absolute gravity separation process (Sink-Float or Heavy Media) are shown in Table VI.

Maximum feed size that can be treated is in the 1-2 in. range and is limited mechanically mainly by the size of opening required to remove sink product. More usually maximum feed size is determined by ore mineralization. Size must be such that an economic amount of concentrate, tailing or both are liberated.

Minimum feed size is determined by the lowest practical rising and settling velocities. With greater proportions of sizes near the lower limit (10 mesh), capacities and/or sharpness of separation decrease.

HEAVY MEDIA SEPARATORS

A variety of different types of equipment is available for carrying out absolute gravity processes.

Cone separators ranging up to 20 ft. in diameter are fed at the top. Float is recovered with the overflow. Sink is removed from the apex of the cone by an air lift or conveyor. The suspension is maintained by agitating with a bladed stirrer.

The classifier separator generally is a standard spiral classifier with minor modification. The internal spiral classifier where the cylinder rotates on a horizontal shaft with spiral lifters is used also.

Drum-type separator is a stationary cylindrical tank with rotating squirrel-cage lifters.

Media solids used most commonly are sand (Chance process for coal), magnetite, ferrosilicon and galena. Solids used for this purpose must have a specific gravity sufficiently high so that the required suspension density is reached at a volume fraction (0.36-0.38) below the range where apparent viscosity increases rapidly. For ores, medium densities range from 2.7 to 3.5.

Further, the solid must be chemically inert, abrasion resistant and easy to separate from fine ore contamination. Magnetite and ferrosilicon are cleaned by magnetic concentration, galena by flotation.

The heavy-density separation process can produce a marketable concentrate from coal, iron, ores and non-metallics. Or it can reject a low-grade tailing to produce an enriched feed for further concentration in the case of either metallic or non-metallic ores. In any case, the possibilities are determined by ore mineralization.

The compelling advantages of the process are its ability to treat coarser particles and separate at a closer specific gravity differential than any other gravity technique. Thus with minimum size reduction, concentrate can be produced. At times coarse waste can be removed by this method to save on subsequent crushing or grinding costs.

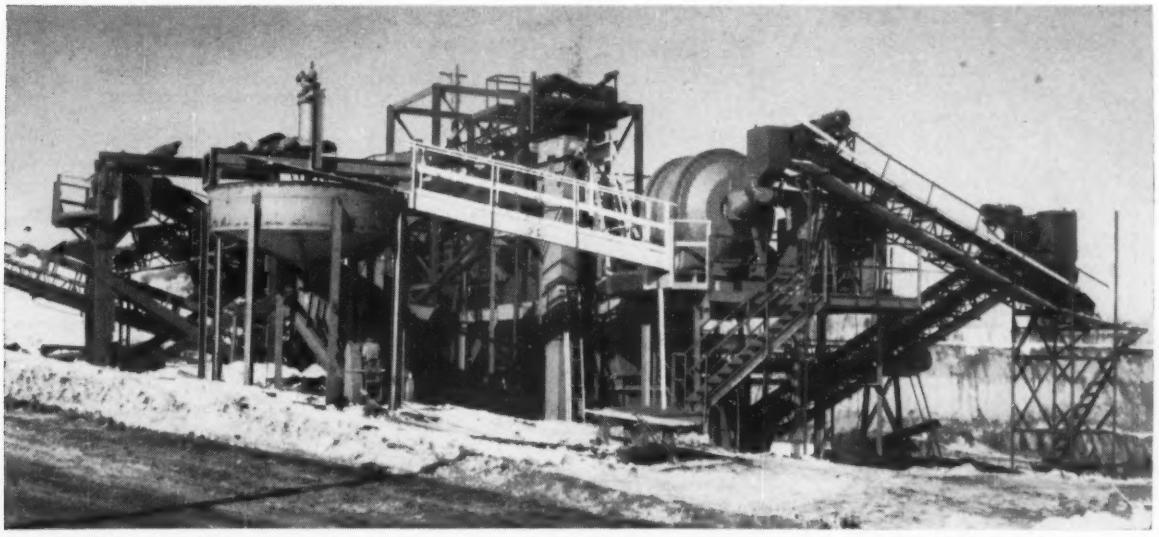
Over 200 plants currently use the process to treat a wide variety of metallic and non-metallic ores. Some of the more unusual applications are to gravel, gypsum, diamond ores, potash, fluorspar, uranium ores, garnet ores, spodumene ores and most of the metallic ores.

Of more recent origin than the true gravity process, the hydraulic cyclone has been used as a vessel for heavy density separations since the mid-40's. The centrifugal field in the cyclone increases particle velocities to extend the lower operating limit down to 48 mesh for ores.

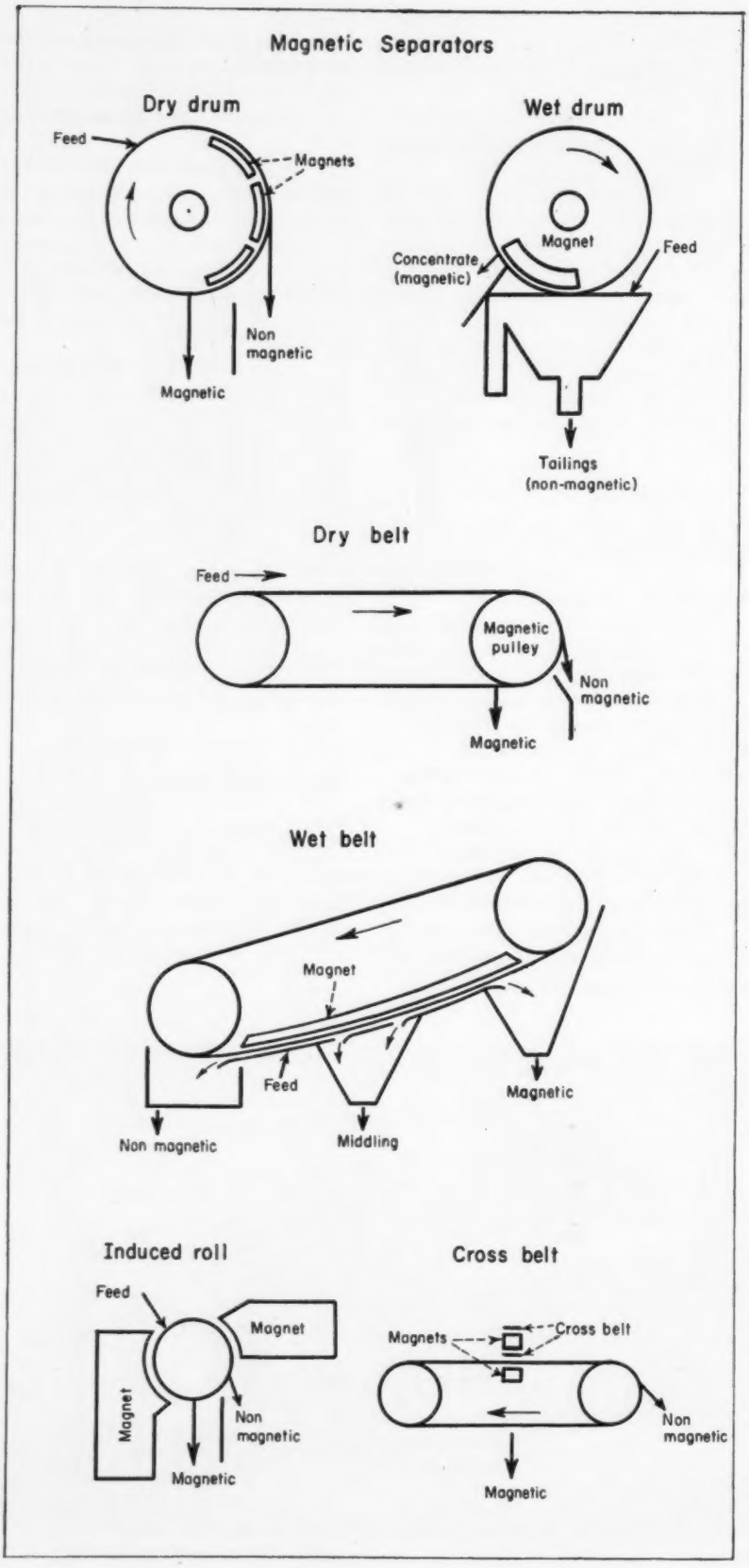
At the present time the cyclone process is applied principally to coal cleaning in Europe and to concentration of non-magnetic iron ores in the United States. In the near future it may be applied to zinc and diamond ores.

Magnetic Separators

Gravity methods of separating solids depend on properties common to all matter in a gravitational field. Magnetic separation depends on the unique behavior of a limited number of solids in a magnetic field. This



COMPLETE packaged heavy media plant on iron range at Virginia, Minn. uses drum separator. (Western Machinery Co.)



behavior consists in developing an attractive force between the particles of one solid and one of the magnetic poles.

Magnetic separators are classified under two broad types according to the method of separation.

The holding type brings both magnetic and non-magnetic particles close to the poles. Magnetic particles are held by the magnetic force until they are carried beyond the point where the non-magnetics are discharged.

With the pickup type as the solids pass under the magnetic poles only the magnetic particles are picked up.

Low intensity separators are used in ore dressing principally for magnetite. Since wet machines are not effective above 6-10 mesh, dry machines are used for coarser feeds. Below this size range wet drum or belt machines are favored for concentrating magnetite.

For more weakly magnetic minerals, high intensity machines are necessary. There are no commercial wet machines of this type. Hence, weakly magnetic materials must be treated in induced roll or cross belt machines using dry feed with size range from about 6 to 100 mesh.

In addition to the magnetic iron oxides, the following minerals are susceptible to commercial magnetic concentration: franklinite, which is zinc-iron silicate; manganese and chromium oxides; rutile, wolframite, and ilmenite. To a minor extent it is used for removing iron-bearing silicates such as mica, hornblende and garnet from other non-metallic minerals.

Electrostatic Separator

Electrostatic separation depends on the varied response of different solids to an electrostatic field.

Conducting particles brought into such a field will become polarized. If in contact with a ground, they lose electrons and then are attracted by an electrode. Non-conductors which are less polarized and which lose electrons more slowly retain a negative charge and are pinned to the roll.

Among the common minerals, approximately a 6-fold range in electrode potential is required to develop repulsion of the mineral by the roll. It follows that a mineral which

is repelled at a low potential can be separated from one which requires a higher potential.

Application of electrostatic separation is in the size range from 8-150 mesh. Feeds must be dry and hot (150-250 F). Feeds must also be closely sized. Because of these limitations, the method is used when a dry process is mandatory or whenever other separating techniques are inapplicable.

Among applications reported are the separation of grindings from abrasives, silicon carbide from alumina, zircon from rutile, chemical salts, and the cleaning of food products.

Flotation

In the United States, substantially all primary copper, lead and zinc minerals are recovered from their ores by flotation. Also, the process is used to recover the minerals of cobalt, germanium, gold and silver, iron, mercury, molybdenum, nickel, tin and tungsten for metal production. And in the nonmetallics, coal, barite, fluorspar, rock, potash, cement rock, glass sands and spodumene.

Minor applications are to industrial wastes, agricultural products and biological materials.

Flotation was applied first commercially in Australia in 1909 to lead-zinc ores. It was adopted rapidly in the United States where it made possible the exploitation of low-grade copper sulfide ores of the Southwest. Further stature was gained when selective methods were developed to separate the sulfide minerals (lead from zinc and copper from iron) and to concentrate non-metallic minerals.

At present, flotation is the only general method, apart from leaching, for concentrating ores containing finely disseminated minerals.

Flotation Practice

Flotation is based on air bubbles attaching themselves selectively to solid particles suspended in water, buoying them to the surface to form a mineral-laden froth.

The process operates continuously as the reagent-treated suspension of solids (pulp) flows through a series of cells. Air is entrained in the suspension by shrouded turbine impellers or is blown into the pulp under pressure.

Froth concentrates are removed by mechanical scrapers or by overflowing. Residue or tailings flow to waste from the end of the series of cells. The first or rough concentrate may be further enriched by resuspending in water and repeating the process.

In order that air bubbles may attach to the mineral particles the particle surfaces must be in a condition to permit the formation of a finite contact angle for the solid-water-air system.

Some mineral surfaces favor this condition naturally. Examples are carbonaceous materials such as coal, diamonds or graphite or materials with a layer lattice such as molybdenite.

When operating commercially on these materials it is necessary only to add hydrocarbon oils and frothers to the agitated ore suspension. The oil, by filming the particle, enhances the potential particle-bubble adhesion. The frother, which is usually an aliphatic, aromatic or terpene alcohol, increases froth stability within desireable limits.

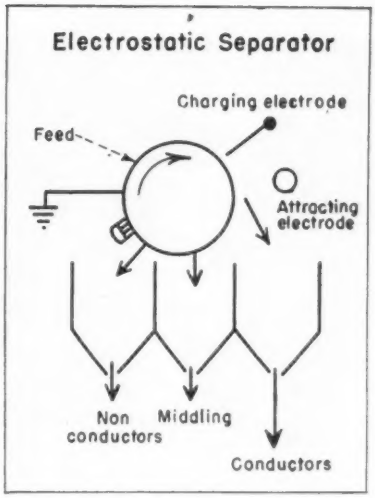
Other minerals in the natural state must undergo surface modification before air bubbles will adhere to them. Most all inorganic minerals fall into this category.

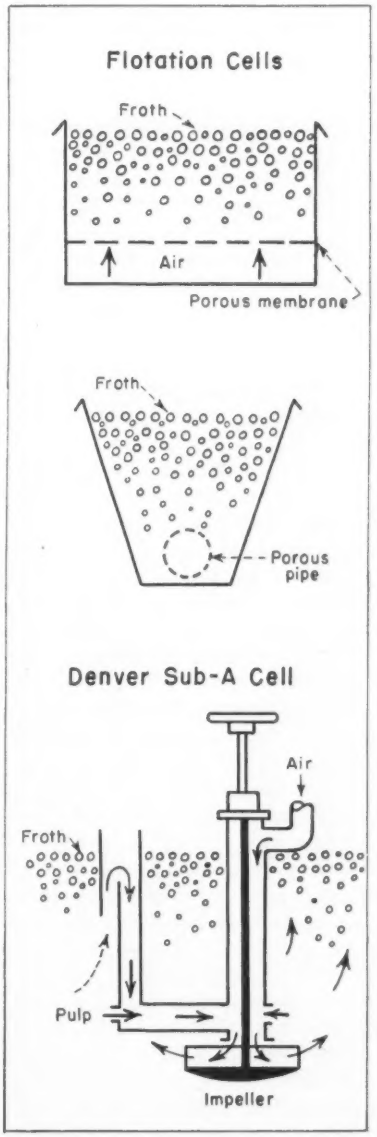
When this type of mineral is treated with a solution or emulsion of the appropriate organic reagent (collector) ions or molecules of acid or base are adsorbed as a surface layer on the mineral particles. Then it is possible for the contact angle to develop.

Both the amount of adsorption and the magnitude of the contact angle are functions of the concentration of reagent in solution. Studies using tracer techniques indicate that the adsorption necessary for flotation corresponds to a small fraction of a collector monolayer on the mineral surface.

Collectors used for sulfide mineral flotation are usually sulfur derivatives. The most common are the alkyl-substituted xanthates and alkyl or aryl substituted dithiophosphates.

For non-sulfide minerals, reagents include the carboxylic acids of animal or vegetable origin such as oleic acid, tall oil and mahogany soaps. Also, aliphatic amines synthesized from





FLOTATION cells of the Fagergren type separate particles of KCl from NaCl at the Potash Co. of America. (Western Machinery Co.)

natural fatty acids. A wide variety of other compounds having the same type of structure are claimed as reagents but are used somewhat less frequently.

In addition to the collector, other supplementary reagents are used in flotation for two general purposes:

- To enhance the collector effect by providing maximum adsorption and bubble adhesion (contact angle) with minimum reagent concentration (activation).
- To prevent or minimize adsorption and bubble adhesion by other ore minerals (depression).

Control of pH is a major factor and is obtained by use of lime, sodium carbonate or sulfuric acid. Since collectors usually are salts of weak acids or bases, the pH will influence the ion-molecule ratio.

Most minerals are the salts or oxides of weakly basic cations or anions. Thus solution pH determines the composition of the mineral surface phase through adsorption of hydroxyl, or hydrogen ion.

Usually it is found that a definite pH range is optimum for each system. Outside this range adsorption of hydrogen or hydroxyl ions may compete with collector adsorption or the collector may be converted to a less strongly adsorbed form which makes for poorer results. Over-all, variation of pH can either activate or depress flotation and is used in both capacities.

When a mineral does not adsorb a collector sufficiently to cause flotation it can be treated with a specific ion to favor adsorption of the collector. For instance, sphalerite (ZnS) is treated with copper sulfate to adsorb cupric ions which in turn promote adsorption of xanthate or dithiophosphate collectors. Or quartz is activated with calcium ion to permit adsorption and flotation with carboxylic ions.

On occasion it may be necessary to prevent simultaneous flotation of two mineral fractions, in order that they may be separated by floating one only. For this purpose, specific depressants provide inorganic ions to adsorb on the mineral fraction and prevent adsorption of the collector.

The effect of the hydroxyl ion in this role has already been noted. Other specific depressants are: cyanide which prevents flotation of zinc sulfides and iron sulfides in the presence of lead or copper sulfides, respectively; dichromates to prevent lead sulfide flotation; and soluble sulfide, such as sodium sulfide or calcium polysulfide, to depress copper and iron sulfides in molybdenite flotation.

High molecular weight organic colloids such as dextrines and tannins give specific depressant effects. Also, they probably function by competitive adsorption.

From Mine to Flotation Concentrate—Table VII

1. Crush dry in stages from run-of-mine sizes to about ¾ in. max.
2. Grind wet in closed circuit with mechanical classifiers to pass about 35 mesh.
3. Treat with reagent both in the grinding circuit and in separate agitated conditioner tanks.
4. Float (rougher stage) to produce a discardable tailing and a first concentrate.
5. Refloat concentrate, often after regrinding and retreatment with reagent.

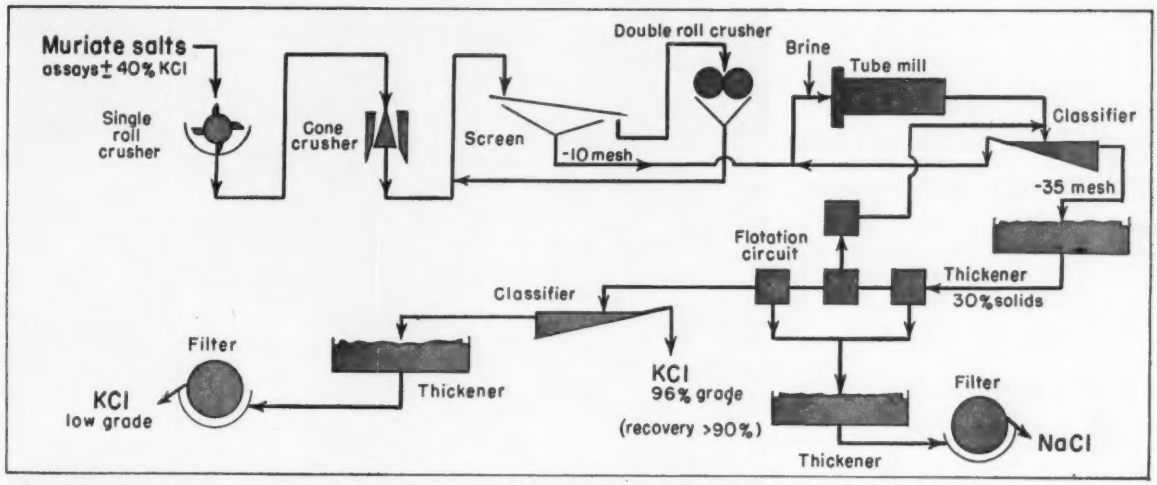
Flotation Machines

Present-day flotation machines operate either pneumatically or mechanically. In the pneumatic type low pressure air acts as a source of bubbles and also agitates the pulp. Mechanical machines agitate the pulp with a rotating mechanism which may also draw air into the pulp, or the air may be fed by external blowers.

Pneumatic cells are open-top troughs. Pulp flows through from end to end with air introduced through either a porous rubber, canvas or pipes.

The rubber or canvas may cover an air box at the bottom of the trough or may be wrapped around a perforated pipe. Although machines using porous media are still found in older plants, they are rarely adopted today.

More widely employed is the principle of aeration through utilization of the air lift principle. Troughs vary in depth from 3 to 10 ft. with lengths up to 100 ft. Air is introduced through small pipes extending to



COMBINATION gravity classification and flotation produce KCl concentrate in a typical potash process.

within 6 in. of the cell bottom and spaced at 3 to 6 in. intervals along the cell.

Vertical or inclined baffles run the length of the cell on either side of the air pipes. The mixture of air and pulp rises between the baffles in the manner of an air-lift pump. As the stream of pulp rises it strikes an appropriate deflecting plate and falls back into the pulp in a space shielded from the froth. Part of the air introduced is dispersed as the result of this agitation within the lift and against the baffling.

All mechanical cells are designed around a shrouded impeller mounted in a rectangular tank. The shroud confines the vortex. Impeller speed and displacement as well as cell depth determine whether the cell will be self-aerating. If not, low pressure air is supplied.

Numerous variations in design of impeller and cell have been advanced over the last fifty years yet today only three or four commercial machines are important. Competitive tests between these units will show economically important differences. However, they are so small that it has not been possible to correlate design with performance.

Design of flotation circuits is infinitely varied and is a tribute to the ingenuity of plant engineering staffs. Pneumatic cells have a standard cross section but are built to the length required for the needed contact time. Mechanical cells are used in series of identical units numbering from 3 or 4 minimum up to 12 or 15.

These arrangements pertain to the first or roughing operation where maximum economic recovery is sought without heed for concentrate grade. Rough concentrate invariably is retreated, often after regrinding, to reach the required grade of concentrate. Intermediate products usually are recycled.

The principal process control variables are those which affect rate of flotation. Starting with the type of mineral being treated other factors related directly to the ore are particle size, specific gravity, ratio of solid to water, concentration of soluble salts in ore and water.

Chemical treatment can be varied through type and concentration of reagents, time and intensity of agitation with reagents, particle size as it affects extent of surface reaction. The total effect of changes in surface chemistry probably is identified with change in the contact angle but cannot be measured practically by observed changes.

Machine variables include cell volumes together with ore-water flow-rate as they affect time for treatment; type and intensity of agitation affecting bubble size and concentration, and affecting particle suspension; cell shape which influences froth volume and depth; frother concentration and identity.

The cumulative effect of all flotation variables can be measured quantitatively in idealized systems by a specific flotation rate. For practical purposes in commercial systems where particle sizes vary widely and ore composition changes frequently, product assay is controlled principally through changing the rate of reagent addition.

In spite of system complexity and crudity of control, results are extraordinary in many cases. For example, more than 90% of a feed mineral often is recovered and in some cases better than 95%.

By repeated retreatment, substantially pure mineral concentrates can be obtained. More usually, concentrate grade is dictated by the balance between the losses entailed in purification and the specification set by the market or the smelter.

Non-Mineral Flotation Processes—Table VIII

Clarification of laundry waste waters.
Clarification of pineapple juice.
Removal of oil from refinery waste waters.
Recovery of wool grease from scouring liquors.
Separation of ergot from rye.
De-inking of paper stocks.
Recovery of silver from spent photographic solutions.
Separation of seeds.
Removal of dyes from suspensions.
Separation of wheat hulls from grain.

You may save considerably by switching from small to large unit loads or vice versa.

Here's how to approach a problem that's well worth investigating.

ECONOMICS OF:

Shipping in Larger Unit Loads

A. K. STRONG, Chemical Construction Corp., American Cyanamid Co.

There are many companies that are now receiving incoming raw materials in conventional small containers. They could and should explore the economics involved in shipping by larger unit load means.

If the investigation is properly made, many companies will find they can save a considerable amount of money by changing existing methods. There will be others that will find that they would not be justified in changing under existing circumstances of volume and distance. However, if more than one commodity is involved, and the materials are compatible, one installation for the handling of larger unit loads may serve one or several commodities.

Let us now consider a typical situation involving the movement of dry, granular, free-flowing materials—and see what the effect of altering size of the unit load will be. This will give you an insight into the economics involved in changing from one method of handling to another.

We will assume that the materials under consideration are free-flowing, not affected by temperature changes, not hygroscopic. Our bags are of a size that can be palletized easily.

Shipments to many customers are in carload lots, the average distance being about 300 miles. At present, our production facility provides bulk storage ahead of the packaging machinery.

We ship in 100-lb. multiwall bags, conveying them directly into the car or highway truck as they are filled.

A crew consisting of a bag-filling operator and one loader in the car, handle five bags per minute, loading out the car in about six man-hours.

The customer's plant is equipped with a fork truck and pallet system. He can unload, palletize at car door and store the above carload in from 12 to 15 man-hours.

He buys 12 to 15 80,000-lb. carloads per year or about one million pounds of materials. He is anxious to reduce his receiving and handling costs and inquires about palletized shipments.

Via Pallets

It now costs us six man-hours to load the car. It costs him 15 man-hours to unload and store. He palletizes at the car door and handles through his process in pallet loads; hence the change to palletized shipments would show labor savings in the unloading operation only. He thinks he might save 12 man-hours per car; at $1.80 per hr., that's $21.60 per carload!

From our point of view, the "colossal savings" accruing from palletized shipments as portrayed by some seem to be strangely absent because:

1. Palletized loads of bagged material require gluing. This costs us about $1.50 per carload.

2. Pallets are needed. Regular 4 × 4 ft. wood units costing $4 each are much too expensive.

There are expendable units available at a lower price. We find one well-known brand available at $1.50 each—these measure 4 × 4 ft. We must place at least 3,000 lb. on each of these units, since we can only load 18 in a

standard 40-ft. car. Theoretically we can place 20 pallets in such a car, but the standard 6-ft. doorway prevents proper maneuvering of power equipment. Instead, we load 18 pallets, or 54,000 lb. We can load over the 60,000-lb. minimum by stacking 80 loose bags in the void space.

If the customer has only a 2,000-lb. capacity fork lift, we can then ship only a 40,000-lb. car. We have learned from bitter experience that none of the expendable pallets available up to late 1954 could be double stacked successfully in a rail shipment.

We, as shippers, cannot afford to absorb the extra labor cost at our end and the high initial cost of the expendable pallet. The customer will object to the higher per ton freight rate caused by the inability to load minimum cars, and quite obviously is not going to stand for an upcharge of

Labor—3 hr. × $1.80	$ 5.40
Pallets—18 × $1.50	27.00
Glue	1.50
Total	$33.90

when he can unload the entire car by hand for $27.

We convey the bags directly from bagger to car. Any attempt to palletize in this type of layout would require either an extra man or, at best, additional equipment in the conveyor line to flatten and glue the bags—and a slightly slower rate of loading by our regular crew. We would, of necessity, need to assemble the unit loads inside the car. It would increase our costs by:

1. Necessary pallets at $1.50 each.
2. Glue.
3. Amortization of special equipment.

We would naturally want to pass this added cost on to the customer.

But, if we moved the bags from filling to a warehouse area, presumably on pallets, and later moved these loads into the car, we could save at least part of the cost of unloading the pallets into the car. This saving might amount to 5 or 6 manhours at $1.80 per hr., or $10.80. Our saving would still not offset the cost of expendable pallets required.

We studied this problem carefully and then developed our own expendable pallet. It costs under 50 c., can be double stacked in the carrier and recovered without product damage, and can be stacked in a warehouse without additional dunnage. From plants using direct conveyor loading, we make a small upcharge which is low enough to permit the customer to make a saving over the old method. Where our products are warehoused on pallets prior to shipment, no such upcharge is necessary.

Via Returnable Containers

Another method of moving dry material involves the use of a collapsible steel wire container, which has a steel pallet as its support. These containers cost about $50 for a 33 cu. ft. size—40 × 48 × 36 in. They are of rugged construction, having been first used in the metal trade. For carrying granular or fine materials, a two-ply paper liner bag is inserted and filled level full with the material to be shipped.

The bag top is folded down and glued or stapled. A wire mesh cover can be provided. Such bags cost about 75 c. each and are used once.

The economics are as follows:

Container cost per trip	$1.00
Bag liner	.75
Freight—one way on 185 lb. pallet	1.85
Return freight KD ½ rate	.90
	$4.50

We feel that while the introduction of the steel containers into our plant would eliminate the labor of bagging and car lining and loading, we could not credit this entire amount to savings. This is because there would be time required to receive, store and assemble the knocked down containers coming from the customer, line and fill them to weight and seal and place them in the car. It seems reasonable that we might extend the cost of the bags as possible savings to the customer.

21 bags at 15 c. each	$ 3.15
Savings per car (36 × 3.15)	113.40
Labor saved by customer (15–3) × $1.80	21.60
Total	135.00
Less costs (36 × $4.50)	162.00
Net loss per car	27.00

(*Continued*)

What Is the Meaning of a Unit Load?

A lot of people will probably take exception to the idea that a 100,000 lb. carload or cargo is a unit load. We commonly refer to any quantity of material larger than the conventional bag, drum or box as semi-bulk or bulk. For example, a hopper car of cement, a gondola load of castings or a tank car or truck load of liquid is commonly referred to as a bulk shipment.

By definition, the term bulk indicates a "mass; an aggregate, especially a mass of some product not packaged, bottled, etc. in the trade."

Actually, the term bulk handling applies where the flow of material is more or less continuous and without benefit of transient containers. It may occur between points within a process or between distant plants, as in the case of the pipeline or cross-country conveyor. Whenever you put material into a container for purposes of storage and/or movement, it becomes a package or unit load. If it is in a bag or box, you may handle each piece separately or you may choose to assemble a number of these pieces on a pallet and handle as a larger unit load.

Small packages such as drums, bags and tote boxes act as portable storage units. They are filled at the end of the production line and contain the material as it is moved through distributive channels to the customer. These packages are convenient, easy to handle either singly or in units with simple equipment. Because of their size, they provide great flexibility in any distributive operation.

After use, most bags and boxes are destroyed. Drums are usually used once for a specific commodity and then disposed of for re-use under less exacting conditions. Only a few of the heavier type drums are actually returnable.

A tank truck holding 2,000 gal., a tank car of 10,000 gal. capacity or a 5 million gal. marine carrier is usually referred to as a bulk carrier. Actually it is simply a larger unit load, but is strictly returnable because of its cost and mobility. Storage and handling facilities are necessary at each end.

Via Returnable Containers

Next logical step is to consider the use of returnable containers fabricated of aluminum measuring 40 × 48 × 72 in. high, completely weather-tight and having a capacity of 72 cu. ft., or a maximum load of 3,000 lb. each. These cost $300 each. They are easily loaded through a special weather-tight port open at the top and are emptied by means of a gasket sealed trap door at the bottom.

Special dumping equipment is available, costing approximately $1,000 per station installed. Our customer requires 80,000 lb. of our material per month. If shipped in a box car, using these containers, this would comprise a carload of 66,000 lbs. We would need to ship a car this size about every three to four weeks.

Containers necessary would amount to:

At the customer's plant	36
In transit (assuming two weeks per round trip per car)	44
Total number of containers	80

This represents a container investment alone of $24,000.

Second major obstacle in the way of this type of shipping is the cost of returning the empty aluminum containers to our plant. The freight on 22 units, weighing 225 lb. each would be the price of a minimum car of 30,000 lb. We would not recommend this kind of installation for such a distance.

Via Covered Hopper Cars

Next step would be to ship by covered hopper car to the customer's plant—he to provide a minimum of equipment for unloading, storing and distributing the material to process.

One method would be to install a simple track level unloading unit, which would discharge into a 72 cu. ft. tote box. These tote boxes would be moved by fork truck to the process and/or storage.

When considering loose carload shipments, the maximum saving that we might pass on to the customer would be $5/ton. This is based on filling and handling labor plus bag cost.

Such equipment would offer little product protection, but would represent the lowest cost installation possible.

Customer's investment in this case would be about as follows (assuming that he owns a fork lift truck, and that there are six points of use in his plant):

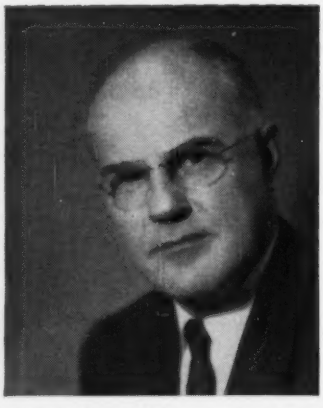
45 tote boxes @ $300	$13,500
Car unloader	2,000
Scale	1,000
Six unloaders @ $1,000	6,000
Erection costs	2,000
	$24,500

Hopper cars necessary for such a transmission can be obtained from the railroad, but if special lining is required to protect the product, it would probably be better to rent such a car from companies specializing in this type of equipment. A fair estimating figure for the use of such a car per year amounts to about $1,800 each, less about 2 c. per mile refund from the railroad for the use of this car.

In other words, a round trip of 600 miles on a 2 c. rebate basis would amount to $12 per round trip. His per ton cost per car is 40 c.

Via Covered Hopper Cars

Should the customer desire storage facilities, and a pneumatic handling system for distribution to his process, his investment would be about as follows:



ALLEN K. STRONG has been head of the material handling division, Chemical Construction Corp. since 1951. He is a past president of the national American Material Handling Society. He was general chairman of the 1951 Materials Handling Conference at Chicago, and is a member of the College-Industry Committee on Material Handling Education and the American Institute of Management.

Air conveyor system	$20,000
Steel storage bin	6,000
Air compressor system	6,000
Concrete pit	2,000
Erection air conv. & compr.	5,000
Total installed	$39,000

Against this fixed charge of $39,000, he can save $5 per ton less hopper car charge of 40 c. or $4.60 net. To write this off in two years, he must ship yearly

$$39{,}000/(2 \times 4.60) \text{ or } 4{,}250 \text{ tons per year.}$$

Via Barges

Shipment by water involves a slightly different approach. In addition to the original $5 per ton saving, there would be a lower freight rate per ton—provided the material is heavy enough to laden the vessel to capacity.

However, pier facilities are necessary, costing from $100,000 to $1 million. Range indicated covers from the minimum requirement to a reasonable facility. Tonnage handled will dictate the amount you can spend.

Load size varies from a 3,500-ton LST to a 15-20,000 ton ore carrier. Unloading facilities must take into account turn-around time. You are allowed 48 hr. in which to unload the barge or boat. After that, it will cost you $1,000/day up for demurrage.

What About Liquid Handling?

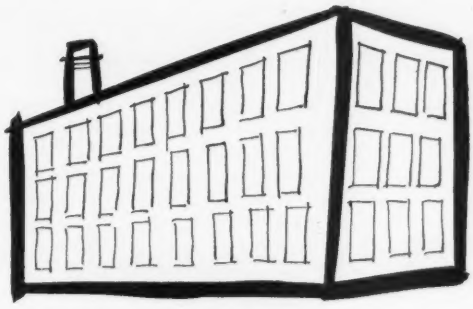
We know of no intermediate steps between car loads of 55-gal. drums and the 2,000-gal. tank truck or 10,000-gal. tank car.

These require loading and unloading facilities. Both supplier and customer will need to invest in storage tanks, pipe lines, pumps, etc., ranging from $20,000 up depending on the type of products.

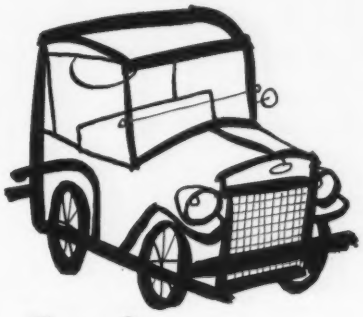
It may be necessary to use inert gas because of explosion hazards. Cost of gas-producing equipment and controls must be added. Material requiring steam-heated storage and steam-traced pipelines will add to the cost.

Savings which the supplier is willing to pass on for bulk shipments such as these will determine the amount of investment you can afford to make. They will probably be somewhere between $3 and $5 per 55-gal. drum.

Replacement Problems:



Your Plant



Your Car

How You Can Get the Best Answers . . .

By Using Capitalized Costs

F. C. JELEN, Allied Chemical & Dye Corp.

YOUR 1949 auto still runs OK. Since that relining job in April the brakes have been fine. Even though six years' parking at the plant has taken its toll on the paint job, those seat covers your wife insisted on buying in June, you're now willing to admit, help you forget the shabby exterior.

But the family chariot has definitely seen better days. You now have to add oil every time you buy gasoline. And you'll have to buy a set of tires and a new battery before winter sets in.

So you start figuring: What would a new car cost me above the trade-in value of my old one? Should I go to an eight-cylinder engine? Is automatic shift worth the extra cost? Or should I keep the old car another year?

In short, you are faced with a problem in economics of replacement.

Industry has many such problems. Technological advancement in the equipment itself, even changes in the quality and form of the acceptable product, all contribute to the obsolescence of existing equipment which is still serviceable to some degree.

In a competitive market our company can remain progressive only in proportion to its willingness to scrap the old for the more economical new. However, we must do this on a sound cost basis. In this article we shall develop exact mathematical relationships for replacement problems on the basis of capitalized cost.

Maintain the Status Quo?

In an earlier article[8] we used the capitalized cost concept as a basis for comparing different choices. Now we shall extend its use to cases where one of the choices is merely continuing with what we have. We shall call the existing item the "Existent" and the new item the "Replacement."

When we choose between Existent and Replacement we simply compare the capitalized cost of keeping the Existent in service with the capitalized cost of its Replacement. If the latter is the smaller then it would pay us to replace now.

"Capitalized cost" is first cost plus present value of an indefinite number of renewals or, more broadly, cost on a perpetual basis.

We do not imply that the item will actually be used forever. "Forever" is merely a common denominator basis on which all service lives can be compared. The capitalized cost of an item is the same, whether at the end of its useful life it is replaced in kind, replaced by something else, or even not replaced at all.

Capitalized cost takes into account the time value of money. For example:

Suppose a condenser costs us $10,000 and lasts 6 years. Assume that money is worth 8% per year. Capitalized cost of the condenser is $27,040. Subtracting the initial cost of $10,000 leaves us $17,040 in excess. If we place

this $17,040 at 8% compound interest for 6 years it will amount to ($17,040) $(1.08)^6$ = $27,040, so we can then spend $10,000 for another condenser.

We can continue the sequence indefinitely. Whether we actually do or not is immaterial.

One Year at a Time

In general we can limit our analysis of replacement costs to the period immediately ahead, usually the next year. This is because operating costs and other disadvantages of the Existent, in most cases, grow more unfavorable as time progresses, and its capitalized cost will increase from year to year. (Exceptions to this rule will be discussed later.)

What is the capitalized cost of the Existent? First of all, if we decide to keep the Existent one more year we forego its present net salvage value L_0. This value is simply what we would get for the Existent in today's market. It is not the Existent's undepreciated book value, or even what it is worth to operations.

Capitalized cost of present salvage value on a one-year basis is

$$K = L_0F_1 \tag{1}$$

F_1 is the one-year value of the general factor,

$$F_m = \frac{(1+i)^m}{(1+i)^m - 1}$$

where m = a time period in years and i = interest rate per year.*

Credited to our capitalized cost is the salvage value L_1 of the Existent one year hence, or

$$K = -L_1G_1 \tag{2}$$

G_1 is the one-year value of the general factor,*

$$G_m = \frac{1}{(1+i)^m - 1}$$

Operating and other expenses for the Existent for the next year will be M, the capitalized cost of which is

$$K = MF_1 \tag{3}$$

Total capitalized cost of the Existent is simply the sum of Eqs. (1), (2) and (3), for they embrace all possible costs.

Example 1—What is the capitalized cost of an Existent, basis one more year service, if the salvage value now is $2,500, $1,500 next year, and immediate operating expenses are $5,000 per year? Money is worth 8%.

$$L_0F_1 = (2{,}500)(13.5) = 33{,}750$$
$$-L_1G_1 = -(1{,}500)(12.5) = -18{,}750$$
$$MF_1 = (5{,}000)(13.5) = 67{,}500$$

Total capitalized cost is $82,500.

What Does Replacement Cost?

Capitalized cost of the Replacement can be computed by the use of one or more of the following equations:

For an item having a first cost C and a service life m years, capitalized cost of the investment is

$$K = CF_m \tag{4}$$

* See nomograph, next page.

For Solving Equations:

We are indebted to Dexter Edge, chemical engineer with Hooker Electrochemical Co., Tacoma, Wash., for the nomograph on the facing page, which solves for I_m and F_m when interest rate i (as %) and years m are known. You can find G_m simply by subtracting 1.0 from the corresponding value of F_m. Similarly, you find $I_{(j-1)}$, F_q or G_p by substituting (j-1), q or p for m.

In sending us this nomograph, Mr. Edge wrote:

"While attempting to put Dr. Jelen's (earlier) article to use, I became puzzled over what to do in cases where fractional years are involved. This eventually led to rearranging the factor equations as follows:

$$(1+i)^m = F_m/(F_m - 1) = (G_m + 1)/G_m = I_m$$

"After converting these to log-log form, it was possible to construct a simple three-line nomograph with F_m, G_m and I_m factors appearing as different scales along one central line. A. C. Malmsten's conclusion that F_m and G_m differed by 1.0 (*Chem. Eng.*, Aug. 1954, pp. 329-330) provided a neat way of combining two of these scales and avoiding confusion when reading three scales drawn along one line."

Although the nomograph can't be read with the accuracy of Dr. Jelen's tables, we believe that it will be adequate for many engineering problems. Where greater accuracy is required, the reader is referred to the tables published earlier (*Chem. Eng.*, Feb. 1954, pp. 199-203)—Ed.

Capitalized cost of its salvage value L after m years (actually a credit, hence negative) is

$$K = -LG_m \tag{5}$$

Capitalized cost of its annual expense M is

$$K = MF_1 \tag{3}$$

this being the same equation as that for the annual expense of the Existent. While M can be either positive or negative, it must be constant every year. (Later we shall learn how to compute capitalized cost when the annual expense is not constant.)

We may encounter some kinds of deferred costs. If the Replacement lasts m years and incurs a cost B_j during the jth year the capitalized cost of the deferred cost is

$$K = B_jF_m/I_{(j-1)} \tag{6}$$

where $I_{(j-1)}$ is the $(j\text{-}1)$ value of the general factor*

$$I_m = (1+i)^m$$

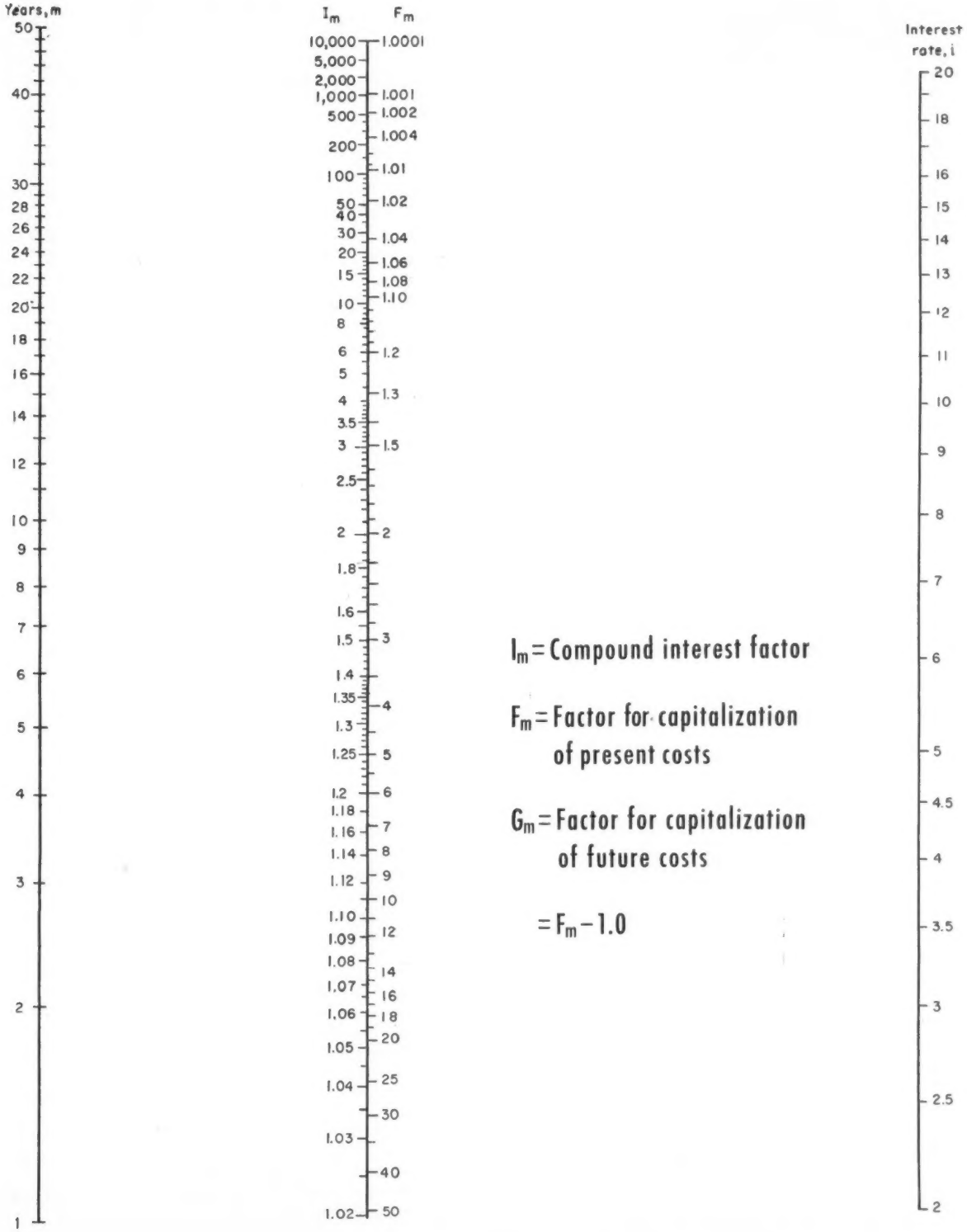
If a Replacement lasting m years is given an overhaul costing H every p years, first starting at the end of p years, capitalized cost of overhaul is

$$K = HG_p \tag{7}$$

A certain violation of Eq. (7) will occur in practice because expiration of the life of an item usually coincides with the time when an overhaul would have been necessary. This overhaul will not be made, and its value H

* See nomograph, next page.

Find Capitalization Factors From This Nomograph



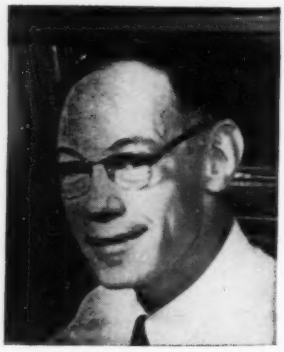
I_m = Compound interest factor

F_m = Factor for capitalization of present costs

G_m = Factor for capitalization of future costs

$= F_m - 1.0$

FREDERIC C. JELEN's earlier article, which introduced the concept of capitalized cost, was so well received that the editor asked him to follow through with further material showing applications of these principles to various types of chemical engineering cost analyses. Dr. Jelen responded with this article on the economic analysis of replacement problems.



The author is a corrosion engineer with Solvay Process Div., Allied Chemical & Dye Corp., Syracuse, N. Y. He is a graduate of Massachusetts Institute of Technology and Harvard and is a licensed professional engineer in New York State.

will be recovered as a salvage value. Thus a more realistic equation for the capitalized cost of overhauls will be

$$K = H(G_p - G_m) \tag{8}$$

Sometimes we run into nonrecurring first costs, such as purchase of a patent. If N denotes their cost the capitalized cost is simply

$$K = N \tag{9}$$

Consider All Costs

In calculations for replacement analysis we must be sure to include all pertinent cost figures. Wherever differences exist we should give them monetary values. Even reduction of an occupational hazard has a monetary value, though it might be difficult to fix the exact value for use in a replacement calculation.

Only differences in cost need be considered, for any cost common to both Existent and Replacement will have no effect on the difference in capitalized cost between the two.

No monetary advantage should be alloted for some potential advantage that will not be realized. For example, a Replacement may have a larger capacity than that of the Existent; but if production is limited by other factors so that installation of the Replacement results in no increase in production, no credit can be given to the Replacement for its greater capacity.

Example 2—We must decide whether or not to replace a turbine-driven blower with a motor-driven one. Since the blower was originally installed, relative energy costs have changed in favor of electric drives.

The existing blower and turbine can be sold now for $800; if used another year they will bring $600. Annual expense is $1,200. The motor-driven replacement will cost $3,000, will incur an annual expense of $1,000 and will last 8 years, with a salvage value at the end of that time of $800. Money is worth 8%.

Cost of Existent, 1 year's service:

$$L_0F_1 = (800)(13.5) = 10{,}800$$

$$-L_1G_1 = -(600)(12.5) = -7{,}500$$
$$MF_1 = (1\,200)(13.5) = 16{,}200$$
$$\text{Total} = 19{,}500$$

Cost of Replacement, 8 years' service:

$$CF_8 = (3{,}000)(2.175) = 6{,}525$$
$$-LG_8 = -(800)(1.175) = -940$$
$$MF_1 = (1{,}000)(13.5) = 13{,}500$$
$$\text{Total} = 19{,}085$$

Comparing cost of Replacement with cost of Existent, it will pay to install the new blower and drive right away.

Replacement of a Process

We can apply these principles to the replacement of an entire process unit, as follows:

Example 3—Our research laboratory has found that we can make electrolytically a product which is now made by a more costly chemical process. The question is whether the new process should be installed at once.

The existing equipment has $10,000 salvage value now, decreasing to $8,000 next year, and an immediate annual expense of $60,000. Equipment for the electrolytic process costs $150,000 and lasts 12 years, with $10,000 salvage value. Its annual operating expense, including electricity, is $75,000, but it will save $35,000 per year in raw material costs, resulting in a net annual expense of only $40,000. Every 3 years the cells will be overhauled at a cost of $30,000, and during the 7th year the auxiliary equipment will be rebuilt at $25,000 cost. A patent must

NOMENCLATURE

B_j	Deferred cost occurring during the jth year, dollars
C	Initial cost of a facility, dollars
F_m	Factor for capitalization of a present cost, $= \dfrac{(1+i)^m}{(1+i)^m - 1}$
G_m	Factor for capitalization of a future cost, $= \dfrac{1}{(1+i)^m - 1}$
H	Deferred cost recurring every p years, dollars
I_m	Compound interest factor, $= (1+i)^m$
i	Interest rate, decimal per year
j	Year during which a deferred cost occurs
K	Capitalized cost, dollars
k	Equivalent uniform yearly cost, dollars per year
L	Salvage value, dollars
L_0	Present net realizable salvage value, dollars
L_m	Salvage value m years hence, dollars
M	Net annual expense, dollars per year
m	Service life of a facility, years
N	Initial nonrecurring cost, dollars
p	Period between recurring deferred costs, years
Q	Amount by which annual expense changes arithmetically, dollars per year per year
q	Period over which a replacement is deferred, years
R	Amount by which improved replacements reduce annual expense, dollars per year per year
s	Rate at which annual expense changes geometrically, decimal per year
W	First year annual expense where annual expense changes geometrically, dollars per year

Replacement Analysis for an Automobile

m (years)	L	Annual Expense	3,500F_m	$-LG_m$	$50F_1 \times (G_1 - mG_m)$	K
1	2,625	0	91,000	−65,625	0	25,380
2	1,969	50	46,375	−24,120	650	22,910
3	1,477	100	31,521	−11,825	1,277	20,970
4	1,108	150	24,105	−6,523	1,888	19,470
5	831	200	19,656	−3,836	2,496	18,320
6	623	250	16,692	−2,348	3,102	17,450
7	467	300	14,578	−1,478	3,699	16,800
8	350	350	12,996	−950	4,285	16,330
9	262	400	11,767	−619	4,865	16,010
10	196	450	10,787	−408	5,434	15,810
11	147	500	9,989	−272	5,993	15,710
12	110	550	9,324	−183	6,539	15,680
13	83	600	8,764	−125	7,085	15,720
14	62	650	8,285	−85	7,618	15,820
15	47	700	7,872	−59	8,138	15,950

be bought outright for $50,000. Money is worth 8%.

Cost of Existent, 1 year's service:

$$L_0F_1 = (10,000)(13.5) = 135,000$$
$$-L_1G_1 = -(8,000)(12.5) = -100,000$$
$$MF_1 = (60,000)(13.5) = 810,000$$
$$\text{Total} = 845,000$$

Cost of Replacement, 12 years' service:

$$CF_{12} = (150,000)(1.659) = 248,500$$
$$-LG_{12} = -(10,000)(0.6587) = -6,590$$
$$MF_1 = (40,000)(13.5) = 540,000$$
$$H(G_3 - G_{12}) = (30,000)(3.851 - 0.6587) = 95,770$$

$$\frac{B_7F_{12}}{I_6} = \frac{(25,000)(1.659)}{(1.5869)} = 26,140$$

$$N = 50,000$$
$$\text{Total} = 953,820$$

Replacement now does not pay—$953,820 capitalized cost against $845,000 for the Existent.

Payout Time for Replacement

We can use the capitalized cost approach to figure payout time, as follows:

Example 4—A process is now controlled manually at a labor cost of $15,000 per year. Installation of electronic controls costing $60,000 will reduce the labor cost to $4,000. Added supervision and maintenance expense will amount to $6,000. However, the electronic equipment will save $15,000 per year in reduction of spoiled product, so that net expense with the new controls will be a savings (negative expense) of $5,000.

Controls of this type are undergoing rapid development and may soon be obsolete. Management wants to know how long it will take for them to pay off if installed now. Money is worth 8%.

Cost of Existent, 1 year's service (no salvage values involved):

$$MF_1 = (15,000)(13.5) = 202,500$$

Cost of Replacement, 3 years' service, zero salvage value:

$$CF_3 = (60,000)(4.851) = 291,060$$
$$MF_1 = -(5,000)(13.5) = -67,500$$
$$\text{Total} = 223,560$$

Cost of Replacement, 4 years' service, zero salvage value:

$$CF_4 = (60,000)(3.774) = 226,400$$
$$MF_1 = -(5,000)(13.5) = -67,500$$
$$\text{Total} = 158,900$$

Payout time on the new controls would be between 3 and 4 years, or about 3½ years.

When Annal Expense Varies

To this point we have assumed that the annual expense is fixed. In practice it is likely to change each year, almost always increasing. Indeed this may be the chief reason why an item can be replaced before it is completely worn out. We must accordingly develop equations for the capitalized cost of varying annual expenses.

Let's look again at Eq. (6):

$$K = B_jF_m/I_{(j-1)}$$

where B_j is a yearly expense occuring during the jth year for an article lasting m years. We can use Eq. (6) for any single year, or term by term for all the years. A more general form is

$$K = F_m \sum_{j=1}^{j=m} \frac{B_j}{I_{(j-1)}} \qquad (10)$$

This is the only equation suitable when the annual expense varies haphazardly.

If annual expense varies systematically we can derive much simpler relationships. The two applications of greatest importance are (a) where annual expense is an arithmetical progression and (b) where it is a geometrical progression.

Suppose annual expense for an item lasting m years is an arithmetical progression. Let the first year annual expense be M, increasing Q per year. The annual expenses then form a sequence

$$M, M + Q, M + 2Q, \ldots\ldots$$
$$M + (m - 1)Q$$

"To remain progressive we must be willing to scrap the old for the more economical new. However, we must do this on a sound cost basis."

and the capitalized cost is

$$K = MF_1 + QF_1(G_1 - mG_m) \qquad (11)$$

The first term on the right, MF_1, is the capitalized cost of the fixed part of the annual expense, M, and is identical with Eq. (3). The other term on the right, $QF_1(G_1 - mG_m)$, is the capitalized cost of the sequence 0, Q, $2Q$, ..., $(m-1)Q$.

If the annual expenses form a geometrical progression we get a different equation. Suppose an item lasts m years and has a first year annual expense W. Let the annual expense increase by a factor $(1 + s)$ each year. The annual expenses then form a sequence

$$W$$
$$(1+s)W$$
$$(1+s)^2W$$
$$\cdots\cdots\cdots$$
$$(1+s)^{m-1}W$$

and the capitalized cost is

$$K = \frac{WG_{m,i}(I_{m,i} - I_{m,s})}{(i-s)/(1+i)} \qquad (12)$$

Double subscripts are used for the G and I factors inasmuch as two rates, i and s, are involved.

Eq. (12) becomes indeterminate for $i = s$, but in this special case it reduces to

$$K = mWF_m \qquad (13)$$

Example 5—A Replacement lasting 5 years will have an annual expense of $3,000 for the first year, increasing $200 per year. If money is worth 8% what is the capitalized cost of the annual expense?

By the general solution using Eq. (10),

$$\frac{B_j}{I_{(j-1)}} = \frac{3{,}000}{1} = 3{,}000$$
$$= \frac{3{,}200}{1.08} = 2{,}963$$
$$= \frac{3{,}400}{1.1664} = 2{,}916$$
$$= \frac{3{,}600}{1.2597} = 2{,}858$$
$$= \frac{3{,}800}{1.3605} = 2{,}793$$
$$\Sigma = 14{,}530$$
$$K = F_5\Sigma$$
$$= (3.131)(14{,}530)$$
$$= 45{,}490$$

Since annual expenses are an arithmetical progression we could have used Eq. (11). With $M = 3{,}000$, $Q = 200$ and $m = 5$, it becomes

$$K = 3{,}000F_1 + 200F_1(G_1 - 5G_5)$$
$$= (3{,}000)(13.5) + (200)(13.5)[12.5 - (5)(2.131)]$$
$$= 45{,}490$$

Example 6—A Replacement lasting 5 years has an annual expense of $3,000 for the first year, increasing 10% over the previous year. If money is worth 8% what is the capitalized cost of the annual expense?

By the general solution using Eq. (10),

$$\frac{B_j}{I_{(j-1)}} = \frac{3{,}000}{1} = 3{,}000$$
$$= \frac{3{,}300}{1.08} = 3{,}056$$
$$= \frac{3{,}630}{1.1664} = 3{,}112$$
$$= \frac{3{,}993}{1.2597} = 3{,}170$$
$$= \frac{4{,}392}{1.3605} = 3{,}228$$
$$\Sigma = 15{,}566$$
$$K = F_5\Sigma$$
$$= (3.131)(15{,}566)$$
$$= 48{,}740$$

Since annual expenses are a geometrical progression we can use Eq. (12). With W = 3,000, $s = 0.10$ and $m = 5$ it becomes

$$K = \frac{3\,000G_{5.8\%}(I_{5.8\%} - I_{5.10\%})}{(0.08 - 0.10)/1.08}$$
$$= \frac{(3{,}000)(2.131)(1.4693 - 1.6105)}{(0.08 - 0.10)/1.08} = 48\,740$$

When to Trade Cars

Example 7—An automobile costs $3,500 new and its trade-in value at the end of each year is 75% of that at the beginning of the year. Assume that annual expense increases $50 per year. If money is worth 4% at what time should replacement be made?

Take a look at the table (p. 185). Col. 2 is trade-in value at the end of the year given in Col. 1. Col. 3 is annual expense during the year, taking first year expense as zero. (Any constant expense common to all years is not relevant, as it will merely increase the capitalized costs a constant amount and not affect the year at which the minimum occurs.) Col. 4 is the capitalized cost of the $3,500 first cost and Col. 5 is that for the trade-in value. Col. 6 is Eq. (11) and gives the capitalized cost of the annual expense. The last column is the sum of Cols. 4, 5 and 6 and is the capitalized cost for various service lives.

Total capitalized cost K is a minimum, $15,680, for 12 years' service; that is the most economical time to trade. The capitalized cost, however, is relatively flat between 7 and 15 years.

No automobile would follow exactly the above schedule of trade-in values and annual expenses, but the figures are suggestive.

We can also show that 12 years is the most economical time to trade by considering the situation at the end of various years. Thus at the end of 11 years, if we were considering purchase of a new automobile we would have:

Cost of Existent, one year's service:

$$L_6F_1 = (147)(26.00) = 3{,}822$$
$$-L_1G_1 = -(110)(25.00) = -2{,}750$$
$$MF_1 = (550)(26.00) = 14{,}300$$
$$\text{Total} = 15{,}372$$

Cost of Replacement, 11 years' service:

$$CF_{11} = (3{,}500)(2.854) = 9{,}989$$
$$-LG_{11} = -(147)(1.854) = -272$$
$$QF_1(G_1 - 11G_{11}) = (50)(26.00)[25.00 - (11)(1.854)] = 5{,}993$$
$$\text{Total} = 15{,}710$$

At the end of 11 years the capitalized cost for one more year of the Existent, \$15,372, is less than that for the Replacement, \$15,710; hence, it is not yet time to trade. We use a service life of 11 years for the Replacement in the above calculation became we are calculating if it pays to go beyond 11 years.

We can repeat this set of calculations for the end of the 12th year. Now the capitalized cost of Replacement is lower than that of the Existent (\$15,680 vs. \$16,385), confirming the previous finding that a 12-year life is the economic optimum for the assumed conditions.

Considering More Than a Year

To this point we have computed capitalized cost of the Existent on the basis of one year more, as generally that will be the most favorable period for the Existent. If more than one year service must be considered, calculation of capitalized cost involves nothing new, but it must be done by the method given for the Replacement.

Cases where the capitalized cost for more than one year's service are less than for just one more year service are usually evident from inspection. In practice they arise principally from two causes: (a) net realizable salvage may decline sharply for the first year; (b) benefits of an overhaul may extend more than one year. Examples of each type follow.

Example 8—An improperly designed pump has an excessive power cost. Salvage value now is \$1,000, decreasing to \$250 next year and to \$100 the following year. Operating cost for one year more is \$700, and \$800 for the following year. A Replacement costing \$3,800 will last 5 years with negligible salvage value. Its operating expense will be uniform at \$400 per year. If money is worth 8% should replacement be made now?

Cost of Existent, 1 year's service:

$$L_0F_1 = (1{,}000)(13.50) = 13.500$$
$$-L_1G_1 = -(250)(12.50) = -3.125$$
$$MF_1 = (700)(13.50) = 9{,}450$$
$$\text{Total} = 19{,}825$$

Cost of Existent, 2 year's service:

$$L_0F_2 = (1{,}000)(7.010) = 7{,}010$$
$$-LG_2 = -(100)(6.010) = -601$$
$$B_1F_2/I_0 = (700)(7.010)/1 = 4{,}907$$
$$B_2F_2/I_1 = (800)(7.010)/1.08 = 5{,}193$$
$$\text{Total} = 16{,}509$$

Cost of Replacement, 5 year's service:

$$CF_5 = (3{,}800)(3.131) = 11{,}800$$
$$MF_1 = (400)(13.50) = 5{,}400$$
$$\text{Total} = 17{,}200$$

Based on only one more year of service the Existent has a higher capitalized cost than that of the Replacement, \$19,825 against \$17,200; but it would be incorrect in this case to replace now. If the Existent is kept for 2 years, and despite its rise in operating cost during the second year, it will have a lower capitalized cost than that of the Replacement, \$16,509 against \$17,200.

In the calculation for the Existent for 2 years we multiplied L_0 by F_2 because Eq. (4) applies, and L_2 is equivalent to a first cost with a service life of 2 years.

Is Overhaul Worth It?

Example 9—A tank with negligible salvage value now or later can be repaired for \$3,000 to extend its life one year, after which \$1,000 per year will extend the life two more years. A new tank costs \$15,000, lasts 10 years with negligible salvage value and has no annual expense. If money is worth 8% should replacement be made now?

Cost of Existent, 1 year's service:

$$MF_1 = (3{,}000)(13.5) = 40\,500$$

Cost of Existent, 3 year's service:

$$CF_3 = (3{,}000)(4.851) = 14{,}550$$
$$B_3F_3/I_1 = (1{,}000)(4.851)/1.08 = 4{,}490$$
$$B_3F_3/I_2 = (1{,}000)(4.851)/1.1664 = 4{,}160$$
$$\text{Total} = 23{,}200$$

Cost of Replacement, 10 year's service:

$$CF_{10} = (15{,}000)(1.863) = 27{,}950$$

Based on one year more service the Existent compares unfavorably with the Replacement, \$40,500 against \$27,950. Based on 3 years more service the Existent is more economical, \$23,200 against \$27,950. In this problem we see readily on inspection that if the Existent is to be continued at all a 3-year period is more favorable than a one-year period.

Wait for Better Model?

Future Replacements may have advantages over the Replacement available now. There may be some gain, therefore, in continuing with the Existent in order to obtain a later model Replacement. This consideration was introduced to replacement analysis by Terborgh.[6] We shall consider the subject on the basis of capitalized cost.

Assume that each year a new Replacement becomes available. The monetary value of the improved design from year to year will be expressed as a reduction in annual expense, and let this yearly reduction be R. All Replacements are assumed to have the same first cost and the same life, m years. The advantage expressed as a capitalized cost in waiting one year for a Replacement is

$$K = R(G_1 - mG_m) \qquad (14)$$

Example 10—What is the advantage, expressed as a capitalized cost, in waiting one year for a Replacement where each year a new model is available having \$100 less annual expense? The Replacement will last 10 years and money is worth 8%.

From Eq. (14),

$$K = 100[12.50 - (10)(0.8629)] = 387$$

The advantage in capitalized cost in waiting one year is \$387. This is applied by subtracting it from the capitalized cost of the Existent where its capitalized cost is based on one year more service.

When the capitalized cost of the Existent is based on more than one year service Eq. (14) is inapplicable, but we can derive a general equation. The advantage expressed as a capitalized cost in waiting q years for a Replacement, where each year a new Replacement becomes available

having R less annual expense, and where each Replacement has a service life of m years and the same first cost, is

$$K = RF_1(G_1 - mG_m)/F_q \qquad (15)$$

Equivalent Uniform Yearly Cost

Thus far all calculations have been expressed as capitalized costs. Management may prefer to see results expressed on a yearly basis. Since capitalized cost represents cost on a perpetual basis, multiplication by the interest rate gives a yearly cost.

Let

$$k = iK \qquad (16)$$

where k is the equivalent uniform (end of year) yearly cost of the capitalized cost. We shall designate it with the abbreviated terminology, "equivalent uniform yearly cost."

Suppose an analysis with money worth 8% showed capitalized costs for Existent and Replacement to be $100,000 and $80,000 respectively. Results can be reported in either of two ways, both equivalent:

(a) Capitalized cost
Existent = $100,000
Replacement = $80,000

(b) Equivalent Uniform Yearly Cost
Existent = $8,000
Replacement = $6,400

The equivalent uniform yearly cost thus involves smaller numbers. In the above illustration the difference between $8,000 and $6,400 is $1,600, and a $1,600 yearly savings may be more significant to some than a $20,000 difference in capitalized cost, although they are equivalent at 8%.

Equivalent uniform yearly cost is not quite the same as yearly cost as the latter term is generally used. Suppose we have a yearly cost of $100,000, with money worth 8%. The capitalized cost by Eq. (3) is

$$K = 100{,}000F_1 = (100{,}000)(13.5) = 1{,}350{,}000$$

and the equivalent uniform yearly cost by Eq. (16) is

$$k = (0.08)(1{,}350{,}000) = 108{,}000$$

The yearly cost of $100,000 becomes an equivalent uniform yearly cost of $108,000. The latter includes $8,000 for interest on the use of $100,000 for one year.

Chose Interest Rate With Care

Capitalized cost is dependent upon the interest rate chosen in the calculation. A high interest rate favors the Existent, a low rate the Replacement. A conclusion which is valid at a low rate can be reversed at a high rate.

This aspect is not peculiar to capitalized cost but is common to all methods where interest is considered. It emphasizes, however, that interest rate be chosen with care. Some analysts use a very high interest rate to insure that limited sums will be spent only with the most profitable replacements. This can be carried to such an extreme that practically no Replacement will seem to pay.

There is no limit to the factors which can be considered in economic analysis by capitalized cost. If obsolescence of the Replacement must be considered, capitalized cost can be combined with probability factors to give the probable capitalized cost. The method was described in the earlier article.[3]

Although the literature[1, 2, 4] on capitalized cost is limited, the concept is ideally suited to making replacement analyses. The method is rigorously exact and its application is relatively simple.

Derivations of Equations

For the derivations of Eqs. (1) through (9), refer to the previous article.[3]

In Eq. (11), derivation of the first term is obvious from the text. For the second term, consider the variable sequence 0, Q, $2Q$, . . . , $(m-1)Q$. Using Eq. (10) with $B_j = (j-1)Q$, we get

$$K = QF_m \sum_{j=1}^{j=m} \frac{j-1}{(1+i)^{(j-1)}}$$

The series represented by Σ is a recurring series of the second order; its solution can be obtained only by advanced mathematics. It reduces eventually to

$$\Sigma = F_1(G_1 - mG_m)/F_m$$

so

$$K = QF_1(G_1 - mG_m)$$

In deriving Eq. (12), the term for the jth year is $(1+s)^{j-1}W$ and Eq. (10) becomes

$$K = WF_{m,i} \sum_{j=1}^{j=m} \left(\frac{1+s}{1+i}\right)^{j-1}$$

The Σ part is a finite geometrical series; the above equation eventually reduces to Eq. (12).

Derivation of Eq. (14) is too involved to give here. Analysis shows that where the yearly reduction in annual expense for each Replacement is R and the service life is m years, the advantage in waiting one year is R per year forever, starting after the first year, less mR every m years, starting after m years. This is

$$K = RF_1/(1+i) - mRG_m = R(G_1 - mG_m)$$

which is Eq. (14).

The value of waiting q years is the present value of waiting for all the individual years, thus

$$K = R(G_1 - mG_m)[1 + 1/(1+i) + 1/(1+i)^2 + \ldots 1/(1+i)^{q-1}]$$

which reduces to Eq. (15).

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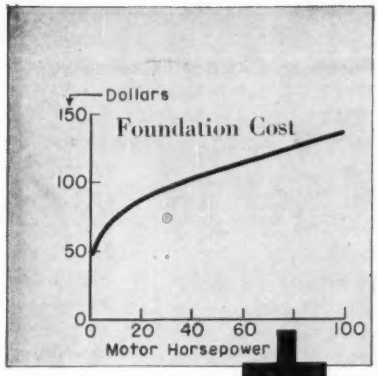
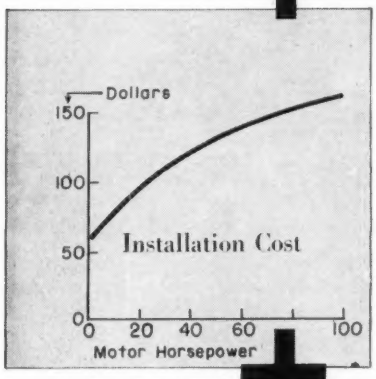
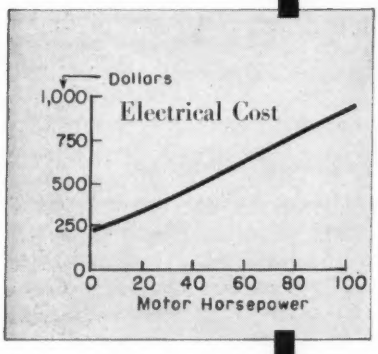
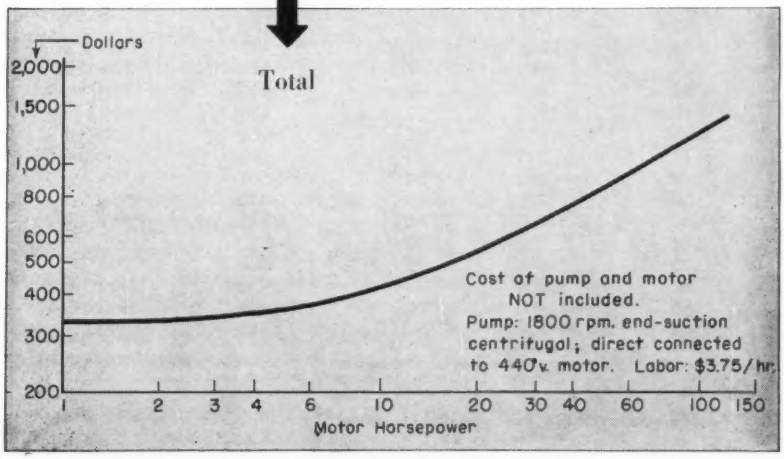
Cost of Installing Centrifugal Pumps









Here are accurate data to help you get a close estimate of the cost involved in installing a single centrifugal pump. You can then add this to the purchase price.

R. W. LUNDEEN AND W. G. CLARK, Dow Chemical Co.

Where you are putting in twenty or thirty centrifugal pumps in a good-sized construction project, installed pump and motor cost data are useful and quite reliable for cost estimating. In such situations, over- and under-estimates on individual units tend to average out. However, the engineer who must make a quick estimate for a single pump installation needs different information than that published to date.

Data of a general type, on installed pump costs, are plentiful. But such information can be quite misleading when applied to a single, specific estimating problem. Standard-fitted pump and motor units of the same horsepower and speed can vary 80-100% in delivered price depending on manufacturer, differences in shaft seals, materials of construction, general quality of workmanship, etc. Such variations in purchase price will obviously lead to substantial differences in installed pump and motor costs.

We encounter the single pump estimate problem frequently, and have prepared the accompanying graph and tables based upon our experience at the Dow Chemical Co. in Pittsburg.

The graph below shows pump and motor installation costs only, vs. motor horsepower. The pumps on which these installation costs are based are standard, end-suction centrifugals with flexible coupling, 1,800 rpm., 440-v., direct-connected, splash-proof motors. To make an installed pump cost estimate, add the installation cost from the graph, to the delivered cost of the pump and motor—this gives you total installed cost. In this fashion, the method takes into account the wide variation in individual pump and motor prices.

Cost Breakdowns

The first table is a breakdown of pump foundation costs. Man-hours include labor for excavation, forming, placing reinforcing rod, fabricating and placing anchor bolts, pouring concrete, stripping forms, sacking and patching. Material costs are figured on the following basis:

4½ sack transit-mix concrete	$13 per yd.
Form lumber	$100 MBFM
Reinforcing rod	9¢ per lb.

The pump installation table, shows total labor required to set the pump on its foundation, install the motor, mount the flexible coupling, fabricate and install the coupling guard and grouting. It also includes painting pump and motor. It does not include any machining on the coupling. If that is required, add one to three

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R. W. Lundeen and W. G. Clark *are with the engineering department of The Dow Chemical Co. at Pittsburg, Calif. Both are active in cost estimating work. Their article on cost of rubber-lined tanks appeared in the March 1955 issue of Chemical Engineering.*

Pump and Motor Foundation

Motor Hp.	Foundation Size (In.) L.	W.	H.	Labor, Man Hours	Material, Dollars
¼–¾	28[1]	20	15	9	8
1–2	32[1]	24	15	9	10
3 and 5	36[1]	24	18	10	14
3 and 5	46[2]	24	18	12	23
7½ and 10	50[2]	24	24	13	27
15–25	54[2]	26	24	14	32
30–50	62[2]	33	30	16	45
60–75	65[2]	38	38	17	50
100	72[2]	44	48	20	60

[1]Single bearing. [2]Double bearing.

Pump and Motor Installation

Motor Hp.	Labor, Man Hours
¼–2	15
3–5	15
7½–10	19
15–25	26
30–40	30
50	35
60–75	40
100	43

Electrical Installation

Motor Hp.	Switchgear* Labor, Man Hours	Switchgear* Material, Dollars	Power & Control Labor, Man Hours	Power & Control Material, Dollars
Thru 7½	7	70	26	35
10–15	10	95	29	49
20–25	11	105	31	62
30–40	17	170	35	85
50	17	175	57	115
60–75	23	340	57	130
100	23	340	78	200

*Includes starter and safety switch in non-hazardous, separately ventilated switch room. Does not include cost of switch rack. Includes push button adjacent to motor.

hours labor. Materials for the pump installation are quite nominal and have been included in the table as equivalent labor.

Electrical Costs

A breakdown of electric motor service costs is shown in the third table. Costs shown are for non-hazardous locations. Safety switches and starters are assumed to be located on existing racks in an existing non-hazardous, separately ventilated switch room. Power and control costs include 100 ft. of conduit, flexible connection at the motor, all wiring and conduit painting. If the motor and pushbutton are located in Class I, Division I hazardous areas, the total installation costs shown on the graph will be increased by 8-10%.

In arriving at the total installation cost curve, all labor was figured at $3.75 per hr.

We want to thank The Dow Chemical Co. for permission to prepare and publish this information.

Typical Costs of Centrifugal Pumps Before Installation[1]

We are indebted to Frank A. Kristal, District Manager, Weinman Pump Mfg. Co., 30 Church St., N.Y.C., for supplying the information used in this table—Ed.

Total Head, Ft.	Capacity Gpm.	Motor Hp.	Dollars (Standard-Fitted)[2]	Dollars (Stainless Steel Wetted Parts)
50	50	1½	227	525
50	100	2	258	590
30	300	3	275	560
20	400	3	286	575
90	200	7½	480	920
75	250	7½	375	700
60	300	7½	400	780
75	400	10	450	800
60	750	15	605	1,250
150	300	20	685	1,300
140	350	20	685	1,300
100	700	25	775	1,450
80	1,000	25	775	1,450
140	500	30	830	1,500
130	600	30	830	1,500
80	1,200	30	930	1,900
60	1,400	30	930	1,900
120	1,400	50	1,200	2,500

[1]For rough estimating only. Pumps complete with base coupling and splash-proof motor of horsepower indicated. Motors are 1,800 rpm., induction type, splash-proof enclosure for 3-phase, 60 cycle, 220 or 440 volts.

[2]Cast-iron casings, steel shafts, bronze impellers, bronze trim.

Engineers and industrial chemists in research, development, equipment design and plant operations throughout the process industries can profit from learning . . .

How to Design Effective Experiments

Statistical approaches can cut down on the number of runs needed, increase accuracy and save time in planning, conducting and interpreting complex experimental work in your lab, plant or office.

F. PROSCHAN, Sylvania Electric Products, Inc. and A. B. BABCOCK, Jr., The Borden Co., Chemical Div.

Knowledge of the most important principles of modern experiment design, along with a grasp of the elements of statistical analysis can be a tremendous help to the chemist or the chemical engineer.

Better planned experiments mean more accurate, more dependable results —often in less time and with less work. Further, the statistical approach can often guide you through a morass of data to a reliable interpretation.

Recent articles in *Chemical Engineering*[1, 2, 3] show the variety of uses which statistical methods have in the chemical industry. Here, we apply them to designing and planning better, more reliable, experiments in the lab, plant or office. We also present a simplified version of the method of statistical analysis of results. Therefore, you can start now in using these techniques.

How Vital Is Planning?

Since an experiment is an attempt to reach a definite, reliable conclusion about the relationship between two or more variables, failure to take into account, in advance, the effect of extraneous factors can lead to a wrong conclusion and negate all efforts. For example:

An engineer wants to learn what slurry density will give the fastest production of solids with a given filter. To discover the relationship between slurry density and production rate, he runs 30 batches—ten at each of three different slurry densities. After gathering the test data, he seeks a statistician's help to reach a reliable conclusion.

While sifting the data, they realize that:

- A new lot of material was used for the last three batches.
- The filter cloth was becoming blinded during test runs.
- The temperature control was poor from batch to batch.

They both agree that the observed production rate differences may have been due to these factors and attributing them to slurry density changes would be a dangerous inference. So the data are thrown out and the engineer goes back to the plant to begin again.

Unfortunately, too many experiments end like this. Lack of planning means wrong answers if the data are taken seriously, or, at least, lost time and effort if the uncompensated factors are recognized. Proper designing aids by identifying these extraneous factors before starting and by minimizing their effects while experimenting.

You're Dead Wrong . . .

. . . if you think that the best way to run an experiment is to keep all variables constant save one. This guarantees nothing but inefficiency.

As A. M. Mood states,* "One well-designed experiment, taking account of all relevant factors, is worth dozens or even hundreds of experiments which study one factor at a time keeping the others constant."

* In his "Introduction to the Theory of Statistics," McGraw-Hill Book Co., New York, N. Y., p. 358.

Here Are The Basics

Modern experiment design rests on a handful of basic principles. These include:

- Anticipate results. Have a conclusion prepared for every possible experimental outcome.
- Randomize. Minimize a built-in bias and the effects of extraneous factors by randomization.
- Increase accuracy. Use uniform units or techniques, enlarge the experiment and plan your treatments to reveal the interaction of the factors.

These require more detailed study before we get into a discussion of some specific experimental designs which you'll find helpful.

Use These Terms Correctly

Accurate	Close to the true value.
Bias	A fixed difference from the true value.
Confidence limits	Numbers between which the true value is presumed to lie — stated with a known risk of error.
Deviation	The amount by which a number in a set of data differs from the mean for the set.
Error	The difference between a measured value and the true value.
Experiment	An organized attempt to determine the relationship between variables.
Factor	The independent variable in an experiment.
Precise	Close to previously obtained values, reproducible.
Random	Subject to chance—without regular order, arrangement or design.
Randomization	The random selection of experimental units.
Replication	The repeated performance of a set of trials.
Significant	Sufficient evidence exists to indicate that an effect occurs—stated with a known risk of error.
Subject	The dependent variable in an experiment.
Treatment	The major independent variable studied in an experiment.

Anticipate Your Results

Before actually performing the experiment, every experimental outcome should be anticipated, and a conclusion should be decided upon for each. There'll be misinterpretation difficulties aplenty if this principle is not followed.

For example, suppose a government laboratory wants to know whether or not an ore supplier's laboratory agrees with it in its analysis for the uranium content of pitchblende. Both laboratories pick specimens from a group of 20 samples and assay them independently.

For ease of discussion, we've listed the lab obtaining the higher value rather than the actual values:

Sample	Lab	Sample	Lab	Sample	Lab	Sample	Lab
1	US	6	US	11	S	16	S
2	S	7	US	12	S	17	S
3	S	8	US	13	S	18	US
4	US	9	US	14	S	19	S
5	US	10	S	15	US	20	US

When the head of the government lab notices the six "US's" in a row (samples 4 through 9), he could conclude that during this period either the US lab was biased toward the high side or the supplier lab was biased toward the low, or both. Yet from the data themselves this sort of inference can be very dangerous and misleading.

It must be realized that every set of data will show some peculiarity or particular configuration. If it hadn't been for the six US's in sequence, he might have looked at the eight S's in the next ten assays (samples 10 through 19) and concluded that bias existed during this period. In fact, to take the extreme case, he could conclude that the entire sequence only represents the result of some clearcut causal system, since, by chance alone, the probability of exactly the sequence above occurring is $(\frac{1}{2})^{20}$ or about 1/1,000,000.

The point is that to reach a definite conclusion we must start with a definite hypothesis. Then we plan the experiment to permit the reliable acceptance or rejection of our hypothesis. This way we know what we are doing, and when we've done it or when we've failed. Otherwise, the best we can hope for from our work is a lead for further investigation and experimentation.

Make a Hypothesis, Test It

Thus in the illustration above, the hypothesis to be tested by the experiment might be: Both labs are essentially in agreement in their analysis of uranium in pitchblende. Now, before beginning the experiment, we consider all possible outcomes and set up a conclusion for each as follows: If either lab gets a higher value 15 or more times out of the 20 trials, a lack of agreement will be indicated and the hypothesis will be rejected. Otherwise, we'll accept the hypothesis as valid.

Note that this takes all possible outcomes into account and the mode of inference has been completely planned before any actual observations are made. The procedure is simple, often it takes only minutes, but it's a vital part of a properly designed experiment.

Randomize to Minimize Bias

We noted above that extraneous factors, present in almost every experimental situation, tend to obscure the relationship being investigated.

For instance, in the above example, suppose the labs obtained their specimens as follows: First, contents of each of the 20 ore bottles were well mixed. Then a scoopful of ore was taken from each sample bottle, placed into a specimen container and sent to the US lab. Then a second spoonful was taken and put in a container for analysis by the supplier.

In this way, it's quite possible that an extraneous factor may have been introduced. Perhaps there's some tendency for the first scoopful to be slightly poorer in uranium than the second because of a tendency of the denser uranium particles to settle. If so, the experiment might falsely show an analysis difference, when the difference actually existed in the sampling procedure.

Randomization could prevent this by assigning the first scoopful to either lab at random. This can be done informally, say by tossing a coin, or, more satisfactorily, by using a table of

random numbers. Thus, using the random numbers in Table I, the following sequence of assigning the first scoopful is determined (letting even digits represent the supplier's lab and the odd the US lab and starting—at random—at the 11th row of the 1st column):

Sample	Digit	Lab	Sample	Digit	Lab
1	9	US	11	1	US
2	8	S	12	4	S
3	5	US	13	9	US
4	2	S	14	0	S
5	0	S	15	5	US
6	1	US	16	6	S
7	7	US	17	8	S
8	7	US	18	6	S
9	6	S	19	0	S
10	7	US	20	7	US

Use It Many Ways

You can use a table of random numbers in a great many useful ways to minimize the risk of bias caused by extraneous factors and to insure that the experimenal inferences are validly derived from the data obtained. Randomization might be applied to the scheduling of test runs on shifts or days of the week, the selection of raw material from large lots, the positioning of samples in test ovens, the assignment of operators to test equipment, the order for running trials and in many, many more ways.

Randomization is one of the modern innovations in experimental design contributed by statistical theory. Because of the extraneous factors likely to be present, randomization becomes a highly important and necessary step in designing chemical engineering experiments.

Increase Experiment Accuracy

An experimental effect is often mistakenly attributed to the factor under study, when actually it may result from the action of other factors or their interaction. Again, the effect of the studied factor may be obscured by a lack of uniformity in the experimental units or by variations in experimental technique. Obviously, these sources of "experimental error" tend to reduce the accuracy of the experiment. Hence, it's imperative to devise methods for boosting experimental accuracy.

The most straightforward way is to refine the experimental procedure by checking the uniformity of test methods or units, taking pains to insure that the different treatments, methods, materials, etc., being compared are applied uniformly, increasing the accuracy of measurements, etc. In search of ways to run better experiments, engineers and chemists often neglect these commonplace, but vital, fundamentals.

Another broad method for boosting experimental accuracy involves increasing the size of the experiment. Roughly, an unbiased estimate based on n experimental units would tend to be half as close to the true value as one based on $4n$ units.

While these methods of increasing experimental accuracy are well known to chemical engineers, other planning

Table I—A List of Random Numbers

10	09	73	25	33	76	52	01	35	86	34	67	35	48	76	80	95	90	91	17	39	29	27	49	45
37	54	20	48	05	64	89	47	42	96	24	80	52	40	37	20	63	61	04	02	00	82	29	16	65
08	42	26	89	53	19	64	50	93	03	23	20	90	25	60	15	95	33	47	64	35	08	03	36	06
99	01	90	25	29	09	37	67	07	15	38	31	13	11	65	88	67	67	43	97	04	43	62	76	59
12	80	79	99	70	80	15	73	61	47	64	03	23	66	53	98	95	11	68	77	12	17	17	68	33
66	06	57	47	17	34	07	27	68	50	36	69	73	61	70	65	81	33	98	85	11	19	92	91	70
31	06	01	08	05	45	57	18	24	06	35	30	34	26	14	86	79	90	74	39	23	40	30	97	32
85	26	97	76	02	02	05	16	56	92	68	66	57	48	18	73	05	38	52	47	18	62	38	85	79
63	57	33	21	35	05	32	54	70	48	90	55	35	75	48	28	46	82	87	09	83	49	12	56	24
73	79	64	57	53	03	52	96	47	78	35	80	83	42	82	60	93	52	03	44	35	27	38	84	35
98	52	01	77	67	14	90	56	86	07	22	10	94	05	58	60	97	09	34	33	50	50	07	39	98
11	80	50	54	31	39	80	82	77	32	50	72	56	82	48	29	40	52	42	01	52	77	56	78	51
83	45	29	96	34	06	28	89	80	83	13	74	67	00	78	18	47	54	06	10	68	71	17	78	17
88	68	54	02	00	86	50	75	84	01	36	76	66	79	51	90	36	47	64	93	29	60	91	10	62
99	59	46	73	48	87	51	76	49	69	91	82	60	89	28	93	78	56	13	68	23	47	83	41	13
65	48	11	76	74	17	46	85	09	50	58	04	77	69	74	73	03	95	71	86	40	21	81	65	44
80	12	43	56	35	17	72	70	80	15	45	31	82	23	74	21	11	57	82	53	14	38	55	37	63
74	35	09	98	17	77	40	27	72	14	43	23	60	02	10	45	52	16	42	37	96	28	60	26	55
69	91	62	68	03	66	25	22	91	48	36	93	68	72	03	76	62	11	39	90	94	40	05	64	18
09	89	32	05	05	14	22	56	85	14	46	42	75	67	88	96	29	77	88	22	54	38	21	45	98
91	49	91	45	23	68	47	92	76	86	46	16	28	35	54	94	75	08	99	23	37	08	92	00	48
80	33	69	45	98	26	94	03	68	58	70	29	73	41	35	53	14	03	33	40	42	05	08	23	41
44	10	48	19	49	85	15	74	79	54	32	97	92	65	75	57	60	04	08	81	22	22	20	64	13
12	55	07	37	42	11	10	00	20	40	12	86	07	46	97	96	64	48	94	39	28	70	72	58	15
63	60	64	93	29	16	50	53	44	84	40	21	95	25	63	43	65	17	70	82	07	20	73	17	90
61	19	69	04	46	26	45	74	77	74	51	92	43	37	29	65	39	45	95	93	42	58	26	05	27
15	47	44	52	66	95	27	07	99	53	59	36	78	38	48	82	39	61	01	18	33	21	15	94	66
94	55	72	85	73	67	89	75	43	87	54	62	24	44	31	91	19	04	25	92	92	92	74	59	73
42	48	11	62	13	97	34	40	87	21	16	86	84	87	67	03	07	11	20	59	25	70	14	66	70
23	52	37	83	17	73	20	88	98	37	68	93	59	14	16	26	25	22	96	63	05	52	28	25	62
04	49	35	24	94	75	24	63	38	24	45	86	25	10	25	61	96	27	93	35	65	33	71	24	72
00	54	99	76	54	64	05	18	81	59	96	11	96	38	96	54	69	28	23	91	23	28	72	95	29
35	96	31	53	07	26	89	80	93	54	33	35	13	54	62	77	97	45	00	24	90	10	33	93	33
59	80	80	83	91	45	42	72	68	42	83	60	94	97	00	13	02	12	48	92	78	56	52	01	06
46	05	88	52	36	01	39	09	22	86	77	28	14	40	77	93	91	08	36	47	70	61	74	29	41
32	17	90	05	97	87	37	92	52	41	05	56	70	70	07	86	74	31	71	57	85	39	41	18	38
69	23	46	14	06	20	11	74	52	04	15	95	66	00	00	18	74	39	24	23	97	11	89	63	38
19	56	54	14	30	01	75	87	53	79	40	41	92	15	85	66	67	43	68	06	84	96	28	52	07
45	15	51	49	38	19	47	60	72	46	43	66	79	45	43	59	04	79	00	33	20	82	66	95	41
94	86	43	19	94	36	16	81	08	51	34	88	88	15	53	01	54	03	54	56	05	01	45	11	76
98	08	62	48	26	45	24	02	84	04	44	99	90	88	96	39	09	47	34	07	35	44	13	18	80
33	18	51	62	32	41	94	15	09	49	89	43	54	85	81	88	69	54	19	94	37	54	87	30	43
80	95	10	04	06	96	38	27	07	74	20	15	12	33	87	25	01	62	52	98	94	62	46	11	71
79	75	24	91	40	71	96	12	82	96	69	86	10	25	91	74	85	22	05	39	00	38	75	95	79
18	63	33	25	37	98	14	50	65	71	31	01	02	46	74	05	45	56	14	27	77	93	89	19	36
74	02	94	39	02	77	55	73	22	70	97	79	01	71	19	52	52	75	80	21	80	81	45	17	48
54	17	84	56	11	80	99	33	71	43	05	33	51	29	69	56	12	71	92	55	36	04	09	03	24
11	66	44	98	83	52	07	98	48	27	59	38	17	15	39	09	97	33	34	40	88	46	12	33	56
48	32	47	79	28	31	24	96	47	10	02	29	53	68	70	32	30	75	75	46	15	02	00	99	94
69	07	49	41	38	87	63	79	19	76	35	58	40	44	01	10	51	82	16	15	01	84	87	69	38

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Table II—Use These Factors for Allowances in Completely Randomized Design—5% Risk

Number in group or range	Number of groups or number of ranges																		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	3.43	2.37	1.78	1.40	1.16	1.00	.87	.78	.70	.66	.63	.58	.50	.47	.44	.42	.40	.38	.36
3	1.91	1.44	1.13	.94	.80	.70	.62	.56	.51	.47	.43	.40	.38	.36	.33	.32	.30	.29	.27
4	1.63	1.25	1.01	.84	.72	.63	.57	.51	.47	.43	.40	.37	.35	.33	.31	.29	.28	.27	.25
5	1.53	1.19	.96	.81	.70	.61	.55	.50	.45	.42	.39	.36	.34	.32	.30	.29	.27	.26	.25
6	1.50	1.18	.95	.80	.69	.61	.55	.49	.45	.42	.39	.36	.34	.32	.30	.29	.27	.26	.25
7	1.49	1.17	.95	.80	.69	.61	.55	.50	.45	.42	.39	.36	.34	.32	.30	.29	.28	.26	.25
8	1.49	1.17	.96	.81	.70	.62	.55	.50	.46	.42	.39	.37	.35	.33	.31	.29	.28	.27	.25
9	1.50	1.18	.97	.82	.71	.62	.56	.51	.47	.43	.40	.37	.35	.33	.31	.30	.28	.27	.26
10	1.52	1.20	.98	.83	.72	.63	.57	.52	.47	.44	.41	.38	.35	.34	.32	.30	.29	.27	.26
11	1.54	1.21	.99	.84	.73	.64	.58	.52	.48	.44	.41	.38	.36	.34	.32	.31	.29	.28	.27
12	1.56	1.23	1.00	.85	.74	.65	.59	.53	.49	.45	.42	.39	.37	.35	.33	.31	.30	.28	.27
13	1.58	1.25	1.02	.86	.75	.66	.59	.54	.49	.46	.42	.40	.37	.35	.33	.32	.30	.29	.27
14	1.60	1.26	1.03	.87	.76	.67	.60	.55	.50	.46	.43	.40	.38	.36	.34	.32	.31	.29	.28
15	1.62	1.28	1.05	.89	.77	.68	.61	.56	.51	.47	.44	.41	.38	.36	.34	.33	.31	.30	.28
16	1.64	1.30	1.06	.90	.78	.69	.62	.56	.52	.48	.44	.41	.39	.37	.35	.33	.31	.30	.29
17	1.66	1.31	1.08	.91	.79	.70	.63	.57	.52	.48	.45	.42	.39	.37	.35	.33	.32	.30	.29
18	1.68	1.33	1.09	.92	.80	.71	.64	.58	.53	.49	.46	.43	.40	.38	.36	.34	.32	.31	.30
19	1.70	1.34	1.10	.93	.81	.72	.65	.59	.54	.50	.46	.43	.40	.38	.36	.34	.33	.31	.30
20	1.72	1.36	1.11	.95	.82	.73	.65	.59	.54	.50	.47	.44	.41	.39	.37	.35	.33	.32	.30

Entries are to be multiplied by the sum of the ranges within groups to obtain allowances for group totals.

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Table III—Use These Factors for Allowances in Randomized Block and Factorial Design—5% Risk

Top entries lead to allowances for column totals
Bottom entries lead to allowances for row means

Number of items per range or number of row means	Number of ranges or number of column totals																		
	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
2	12.71 6.36	3.84 1.23	2.25 .52	1.74 .34	1.36 .23	1.13 .17	.97 .14	.84 .11	.76 .093	.68 .079	.64 .068	.61 .060	.56 .053	.49 .047	.46 .043	.44 .039	.41 .035	.39 .032	.37 .030
3	3.90 2.18	2.01 .67	1.41 .36	1.10 .23	.90 .17	.77 .13	.68 .10	.60 .084	.54 .071	.50 .060	.46 .052	.42 .046	.39 .041	.37 .037	.35 .034	.33 .030	.31 .027	.30 .025	.28 .023
4	2.91 1.50	1.66 .54	1.21 .30	.97 .20	.81 .15	.70 .11	.61 .090	.55 .074	.50 .062	.45 .053	.42 .046	.39 .041	.36 .036	.34 .033	.32 .030	.30 .027	.29 .024	.27 .023	.26 .021
5	2.53 1.29	1.55 .47	1.14 .28	.92 .18	.77 .13	.67 .10	.59 .083	.53 .069	.48 .058	.44 .050	.41 .043	.38 .038	.36 .034	.33 .030	.31 .028	.30 .025	.28 .023	.27 .021	.26 .019
6	2.39 1.16	1.50 .45	1.13 .26	.91 .18	.77 .13	.66 .099	.59 .079	.53 .065	.48 .055	.44 .047	.41 .041	.38 .036	.35 .032	.33 .029	.31 .026	.30 .024	.28 .022	.27 .020	.26 .019
7	2.33 1.08	1.48 .43	1.12 .25	.91 .17	.77 .12	.67 .095	.59 .076	.53 .063	.48 .053	.44 .046	.41 .040	.38 .035	.36 .031	.33 .028	.32 .026	.30 .023	.28 .021	.27 .020	.26 .018
8	2.29 1.00	1.48 .41	1.12 .24	.91 .16	.77 .12	.67 .092	.59 .074	.53 .062	.49 .052	.45 .045	.41 .039	.38 .034	.36 .030	.34 .027	.32 .025	.30 .023	.29 .021	.27 .019	.26 .018
9	2.29 .97	1.48 .40	1.13 .23	.92 .16	.78 .12	.68 .090	.60 .073	.54 .060	.49 .051	.45 .044	.42 .038	.39 .034	.36 .030	.34 .027	.32 .024	.31 .022	.29 .020	.28 .019	.27 .017
10	2.30 .93	1.50 .39	1.14 .23	.93 .16	.79 .11	.69 .089	.61 .071	.55 .059	.50 .050	.46 .043	.42 .037	.39 .033	.37 .029	.35 .026	.33 .024	.31 .022	.29 .020	.28 .018	.27 .017
11	2.31 .90	1.52 .38	1.15 .22	.95 .15	.80 .11	.70 .087	.62 .070	.56 .058	.51 .049	.47 .042	.43 .037	.40 .033	.38 .029	.35 .026	.33 .024	.32 .021	.30 .020	.29 .018	.27 .017
12	2.32 .88	1.54 .37	1.17 .22	.95 .15	.81 .11	.71 .086	.63 .069	.56 .057	.51 .049	.47 .042	.44 .036	.41 .032	.38 .029	.36 .026	.34 .023	.32 .021	.30 .019	.29 .018	.28 .016
13	2.34 .86	1.56 .37	1.19 .22	.97 .15	.82 .11	.72 .085	.64 .069	.57 .057	.52 .048	.48 .041	.44 .036	.41 .032	.39 .028	.36 .025	.34 .023	.33 .021	.31 .019	.30 .018	.28 .016
14	2.37 .85	1.58 .36	1.20 .22	.98 .15	.83 .11	.73 .084	.65 .068	.58 .056	.53 .048	.49 .041	.45 .036	.42 .032	.39 .028	.37 .025	.35 .023	.33 .021	.31 .019	.30 .017	.29 .016
15	2.39 .84	1.60 .36	1.22 .21	1.00 .15	.85 .11	.74 .083	.66 .067	.59 .056	.54 .047	.49 .041	.46 .035	.43 .031	.40 .028	.38 .025	.35 .023	.33 .021	.32 .019	.30 .017	.29 .016
16	2.42 .82	1.62 .36	1.24 .21	1.01 .14	.86 .11	.75 .083	.66 .067	.60 .055	.54 .047	.50 .040	.46 .035	.43 .031	.41 .028	.38 .025	.36 .022	.34 .020	.32 .019	.31 .017	.29 .016
17	2.44 .82	1.63 .35	1.25 .21	1.03 .14	.87 .11	.76 .082	.67 .066	.61 .055	.55 .046	.51 .040	.47 .035	.44 .031	.41 .027	.39 .025	.36 .022	.35 .020	.33 .019	.31 .017	.30 .016
18	2.46 .80	1.65 .35	1.27 .21	1.04 .14	.88 .10	.77 .082	.68 .066	.61 .054	.56 .046	.51 .040	.48 .035	.44 .031	.42 .027	.39 .024	.37 .022	.35 .020	.33 .018	.32 .017	.30 .016
19	2.49 .80	1.67 .35	1.28 .21	1.05 .14	.89 .10	.78 .081	.69 .066	.62 .054	.57 .046	.52 .040	.48 .034	.45 .030	.42 .027	.40 .024	.37 .022	.35 .020	.34 .018	.32 .017	.31 .016
20	2.52 .79	1.69 .34	1.29 .21	1.06 .14	.90 .10	.79 .081	.70 .065	.63 .054	.57 .046	.53 .039	.49 .034	.47 .030	.43 .027	.40 .024	.38 .022	.36 .020	.34 .018	.33 .017	.31 .016

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methods which make for greater accuracy are not so widely known.

In many experiments, the factors under consideration do not act independently. For example, in studying the effect of pH and temperature on the yield of a precipitant, it's suspected that the temperature effect depends on the value of pH being used. In such a case, an experiment carried out in the classical tradition, keeping one variable constant, would make it difficult if not impossible to determine the influence of pH.

In addition the experimenter must run many more trials under the classical arrangement than under the modern factorial design to achieve the same precision. Factorial design is advantageous in this type of experiment.

In factorial design, all combinations of the variables are studied at several levels. For example, the pH-temperature set-up is:

Factorial Design Set-Up

	T_1	T_2	T_3	T_4
pH_1	Y_{11}	Y_{12}	Y_{13}	Y_{14}
pH_2	Y_{21}	Y_{22}	Y_{23}	Y_{24}
pH_3	Y_{31}	Y_{32}	Y_{33}	Y_{34}
pH_4	Y_{41}	Y_{42}	Y_{43}	Y_{44}

Thus Y_{11} represents the yield obtained using the combination temperature T_1 and pH_1, Y_{12} is the yield using T_2 and pH_1, etc. Using factorial design, the effects of both pH and temperature on yield can be studied and recorded with the same precision as can be obtained in the same size experiment performed under the classical arrangement.

With factorial design, any inference about the effect of temperature is based on four levels of pH, not one. Hence, the experimental conclusion could more readily apply to actual industrial or laboratory practice where all other factors could not be held constant.

And the fact that you can readily apply it to actual practice is one of the chief advantages of modern experimental design. It equips the chemical engineer with a sharp tool both for developing new processes and for making present operations run nearer the optimum.

In addition, by studying the effects of several factors simultaneously, it results in more accurate and valid conclusions with no more (and often less) experimental effort.

Use These Three Types of Designs

- **Completely randomized design for homogeneous material.**
- **Randomized blocks with non-uniform experimental units.**
- **Factorial design to study the interaction of factors.**

After touching on the fundamentals of experiment design, let's explore three specific design methods which have wide application throughout chemical engineering practice. We've illustrated our discussion with such practical examples.

First, we'll consider the arrangement of experimental trials.

Completely Randomized Design

Suppose it's necessary to determine which of four methods of reducing a metal oxide yields the most metal. After thoroughly mixing, the experimenter takes 20 samples, planning to apply methods 1, 2, 3 and 4 to five samples each. However, to avoid any possibility of extraneous factors obscuring the effects of the methods, he selects the sequence of treatments in a random order as follows:

Sample Number	Reduction Method	Sample Number	Reduction Method
1	4	11	1
2	4	12	4
3	3	13	3
4	3	14	1
5	1	15	3
6	2	16	1
7	4	17	2
8	1	18	2
9	2	19	4
10	2	20	3

To assign the reduction methods, the experimenter uses the table of random numbers like this. First, he picks a starting place "at random"—say, the 16th row and the 1st column. Since 20 sample bottles are used, he reduces each of the 2 digit numbers in the row to the remainder by dividing by 20. Thus, 65 becomes 5, 48 becomes 8, 11 remains 11, etc. Then he assigns method 1 to the bottles represented by the first five different reduced numbers not yet encountered, and so on. The best way to understand the procedure and appreciate its simplicity is to actually check the above results.

After applying the methods in this random sequence, he gets the results listed on p. 196. From these he must decide whether the four methods really differ in their reduction efficiency and by how much. This requires the appropriate statistical test of significance.* Specifically, the first question he wants answered is: Are the observed differences among the four methods real or simply the results of experimental error in sampling and analysis?

To get the answer, he goes to Table II and looks under the number of treatments (4) and across at the number of experimental units per treatment (5). Here he finds a factor, 0.96 He multiplies the sum of the ranges, 0.61, by this factor. He gets the allowance, 0.59.

He can now state that any pair of treatment totals that differ by more than 0.59 represent reduction methods that are truly different in their ability to reduce the oxide. On the other hand, a difference of 0.59 or less may result from chance fluctuations—and the methods will not have been proved different in their ability to reduce the oxide.

In terms of treatment means rather than totals, a difference of 0.59/5 or 0.118 is the allowance for the difference between a pair of treatment means.

Comparing the methods in pairs, the experimenter finds that 1 and 2 differ significantly, since the totals differ by 0.64. Similarly, he can show that method 2 exceeds all other methods, but he can't establish any significant differences among the remaining methods.

As indicated by the heading on Table II, it is so constructed that the risk that a difference will be established when it doesn't actually exist is 5% in any given experiment. Using standard statistical terminology, as explained previously,* Table II's level of significance is 5%.

One final technical point on the application of Table II. A normal distribution of fixed variance is assumed for the observations obtained in each treatment. This is usually more or less

* For a look into the mechanics of these tests see *Chem. Eng.*, Sept. 1954, p. 193.

the case in many chemical engineering applications.

How Much Better?

An interesting question arises here. How good is method 2? By how much does it exceed the other methods in ability to reduce oxides? The comparison gives the answer.

It shows how to get "confidence limits" on the real difference between methods. The observed difference between methods 2 and 3, for instance, is 0.61. This is alternately increased and decreased by the allowance, 0.59, previously calculated from Table II, and the resulting limits on totals, 0.02 and 1.20, are divided by the number of samples (5) to yield the limits on means, 0.004 and 0.240.

To the experimenter this means that method 2 tops method 3 by an amount which is somewhere between 0.004 and 0.240. Similarly, method 3 is superior to method 4 by an amount which is somewhere between −0.004 (method 4 superior) and 0.232. Thus method 3 hasn't been conclusively shown to be superior to 4 since the real difference may be in either direction. In making these statements, the experimenter again takes a 5% risk of being wrong.

Use It This Way

The completely randomized design results, of course, from the random assignment of the treatments to the experimental units. In order to use the critical factors of Table II, though, the number of experimental units assigned to each treatment shoud be the same. If they aren't, another method of statistical analysis[4] is appropriate.

This design is useful when the experimental material is homogenous. For example, the oxide used in the reduction experiment was well mixed and quite uniform, hence, the randomized design to compare the four reduction methods was an appropriate choice.

Amount of Metal Made, Lb.

	Method 1	Method 2	Method 3	Method 4
	1.76	1.85	1.69	1.72
	1.68	1.78	1.84	1.63
	1.82	1.93	1.78	1.59
	1.71	1.87	1.79	1.62
	1.78	1.96	1.68	1.65
Total	8.75	9.39	8.78	8.21
Mean	1.750	1.878	1.756	1.642
Range	0.14	0.18	0.16	0.13

Sum of ranges 0.61

Comparing the Methods

	Methods 2-3	Methods 3-4
Difference in totals	0.61	0.57
Allowance	±0.59	±0.59
Limits on totals	0.02 to 1.20	−0.02 to 1.16
Limits on means	0.004 to 0.240	−0.004 to 0.232

Using Randomized Blocks

Where experimental materials, techniques or conditions aren't uniform or homogenous, it helps to group the experimental units to reduce or separate out the effects of extraneous factors. For instance, a manufacturer of formed plastic products wants to learn whether different methods of die lubrication would affect the quality of his product as measured by its density.

His press forms six units of the product per stroke, so he decides to assign each of the lubrication methods to a die within each run of six. In this way, variations in the plastic material will not obscure the effects of the lubricants. By the same token, differences in technique, variations in the measuring instruments, etc., tend to be much larger between runs than within runs, and will, therefore, not diminish the accuracy of the comparison to any large extent.

The six dies within each of 20 runs are assigned at random (using Table I) to the six lubricants and the runs are made. Results of the experiment are given at right.

He notes that the lubricants do differ in their effect on product density. But are the observed differences between methods statistically significant, or simply the work of chance? A statistical test of significance yields the answer.

The experimenter first totals the deviations from the mean for each run to serve as a check on the computations—were it not for rounding errors each total would be 0, however, since the mean and the deviations are given to only two places, the total may be off by ±0.03. (In general, the maximum error in the total is one-half the number of columns times the smallest unit of measurement used.)

Next, from Table III, there are two

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factors for the number of ranges (6) and the number of items per range (20); 0.90 and 0.10. Multiply these factors by the sum of the ranges, 0.64, getting 0.58 and 0.06.

The former represents the allowance for the column totals. If two lubricant totals differ by more than 0.58, he concludes that a real difference exists between the two. Thus lubricant 5 is definitely superior to 2 which, in turn, is definitely superior to 1, 3 and 6. And 4 definitely rates over 1, 3 and 6., although it isn't significantly different from lubricants 2 or 5.

Similarly, 0.06 represents the allowance for run means. If two run means differ by more than 0.06, it's safe to conclude that a density difference exists. However, in this experiment comparisons between runs don't mean as much as comparisons between lubricants.

As in the discussion of completely random design, the experimenter can calculate a confidence interval for the difference between any pair of lubricants.

This simply involves getting the difference in totals and increasing and decreasing it by the allowance, 0.58. This sets the limits within which the true value may be presumed to lie.

Table III is so constructed that the risk of error is again 5 in 100. The risk of setting up one or more incorrect limits on the difference between treatments is also 5%.

What's Behind It

The randomized block design simply involves dividing the experimental units into groups which are as alike as possible. Then each unit in the block gets a different treatment, assigned at random. Layout of the randomized block design is, in general, as follows (letters *A, B, C, D,* and *E* representing different treatments):

Block 1 *A B D C E*
Block 2 *C E B D A*
Block 3 *E A C B D*
Block 4 *B E D C A*
etc.

The whole point of this design is that variations between blocks do not affect the accuracy of the comparison between treatments since this is made within each of the blocks. Thus the experiment becomes considerably more sensitive and efficient. There are many opportunities to use this type of design in chemical engineering practice.

Planning With Factorial Design

Many times the chemical engineer wishes to study the effect of several important factors. Under the classical approach, the effect of each factor would be studied separately. With factorial design, the effect of each factor and the interaction between factors can be determined in one experiment with considerably less work.

Let's define the characteristics of this type of experiment. Suppose factor 1 is to be studied at levels *A, B, C, D, E* and factor 2 at levels *a, b, c, d*. Using factorial design, the experiment would be arranged as at the top of the next page. Note that all possible combinations of the two variables are used. The treatment combinations are then performed in a random order.

Again, a table of random numbers should be used to insure that the treatment combinations will be performed at random.

Both variables are studied with as much accuracy as if the experiment had been devoted to just one. Hence, in this respect the factorial experiment is twice as efficient as the classical type.

To study interaction each treatment is performed twice, thus permitting an estimate of "experimental error" to be made. This estimate would then be used as a basis for deciding whether the observed interaction was significant or not.[5]

The forms of the factorial design and of randomized block experiments are essentially the same. The only difference is that in the randomized block design, one of the variables is a replication. The statistical analysis is essentially the same, the factors of Table III are used in both cases. For example, consider the following situation:

For equipment design purposes the

Results of Lubricant Experiment, Lb./Cu.Ft.

	Lubricant							
Run	1	2	3	4	5	6	Total	Mean
1	7.68	7.71	7.64	7.72	7.75	7.66	46.16	7.69
2	7.64	7.71	7.65	7.70	7.70	7.63	46.03	7.67
3	7.71	7.72	7.66	7.74	7.76	7.69	46.28	7.71
4	7.58	7.59	7.52	7.58	7.70	7.62	45.59	7.60
5	7.72	7.75	7.74	7.74	7.78	7.71	46.44	7.74
6	7.60	7.59	7.62	7.70	7.68	7.58	45.77	7.63
7	7.63	7.65	7.61	7.69	7.70	7.60	45.88	7.65
8	7.59	7.71	7.70	7.68	7.72	7.72	46.12	7.69
9	7.51	7.68	7.52	7.64	7.65	7.50	45.50	7.58
10	7.62	7.65	7.60	7.67	7.63	7.53	45.70	7.62
11	7.58	7.63	7.61	7.66	7.70	7.61	45.79	7.63
12	7.63	7.72	7.62	7.70	7.68	7.68	46.03	7.67
13	7.68	7.73	7.66	7.75	7.78	7.67	46.27	7.71
14	7.65	7.70	7.64	7.73	7.77	7.66	46.15	7.69
15	7.52	7.57	7.51	7.59	7.55	7.55	45.29	7.55
16	7.68	7.68	7.69	7.73	7.78	7.65	46.21	7.70
17	7.71	7.74	7.70	7.77	7.81	7.68	46.41	7.74
18	7.61	7.70	7.60	7.70	7.73	7.64	45.98	7.66
19	7.53	7.59	7.55	7.63	7.61	7.54	45.45	7.58
20	7.63	7.68	7.62	7.69	7.75	7.64	46.01	7.67
Total	152.50	153.50	152.46	153.81	154.23	152.56	919.06	
Mean	7.625	7.675	7.623	7.690	7.712	7.628		

Deviations From the Run Mean

	Lubricant						
Run	1	2	3	4	5	6	Total
1	−0.01	+0.02	−0.05	+0.03	+0.06	−0.03	+0.02
2	−0.03	+0.04	−0.02	+0.03	+0.03	−0.04	+0.01
3	0.0	+0.01	−0.05	+0.03	+0.05	−0.02	+0.02
4	−0.02	−0.01	−0.08	−0.02	+0.10	+0.02	−0.01
5	−0.02	+0.01	0.0	0.0	+0.04	−0.03	0.0
6	−0.03	−0.04	−0.01	+0.07	+0.05	−0.05	−0.01
7	−0.02	−0.0	−0.04	+0.04	+0.05	−0.05	−0.02
8	−0.10	+0.02	+0.01	−0.01	+0.03	+0.03	−0.02
9	−0.07	+0.10	−0.06	+0.06	+0.07	−0.08	+0.02
10	0.0	+0.03	−0.02	+0.05	+0.01	−0.09	−0.02
11	−0.05	0.0	−0.02	+0.03	+0.07	−0.02	+0.01
12	−0.04	+0.05	−0.05	+0.03	+0.01	+0.01	+0.01
13	−0.03	+0.02	−0.05	+0.04	+0.07	−0.04	+0.01
14	−0.04	+0.01	−0.05	+0.04	+0.08	−0.03	+0.01
15	−0.03	+0.02	−0.04	+0.04	0.0	0.0	−0.01
16	−0.02	−0.02	−0.01	+0.03	+0.08	−0.05	+0.01
17	−0.03	0.0	−0.04	+0.03	+0.07	−0.06	−0.03
18	−0.05	+0.04	−0.06	+0.04	+0.07	−0.02	+0.02
19	−0.05	+0.01	−0.03	+0.05	+0.03	−0.04	−0.03
20	−0.04	+0.01	−0.05	+0.02	+0.08	−0.03	−0.01
Range.	0.10	0.14	0.09	0.09	0.10	0.12	

Sum of ranges 0.64.

Combine Factors Like This for Factorial Designs

	Factor 1				
Factor 2	**A**	**B**	**C**	**D**	**E**
a	**aA**	**aB**	**aC**	**aD**	**aE**
b	**bA**	**bB**	**bC**	**bD**	**bE**
c	**cA**	**cB**	**cC**	**cD**	**cE**
d	**dA**	**dB**	**dC**	**dD**	**dE**

Corrosion Rates of Alloy Specimen, Mils per Yr.

	%HNO_3					
%Cl	**10**	**15**	**25**	**50**	**Total**	**Mean**
0.00	0.43	0.36	0.38	0.24	1.41	0.35
0.01	0.46	0.37	0.40	0.55	1.78	0.44
0.05	0.51	0.48	0.48	0.62	2.09	0.52
0.20	0.69	0.62	0.66	0.76	2.73	0.68
1.00	0.73	0.67	0.60	1.08	3.08	0.77
2.00	0.83	0.78	0.83	1.21	3.65	0.91
Total	3.65	3.28	3.35	4.46	14.74	
Mean	0.61	0.55	0.56	0.74		

Deviations From the %Cl Mean

	%HNO_3				
%Cl	**10**	**15**	**25**	**50**	**Total**
0.00	+0.08	+0.01	+0.03	−0.11	+0.01
0.01	+0.02	−0.07	−0.04	+0.11	+0.02
0.05	−0.01	−0.04	−0.04	+0.10	+0.01
0.20	+0.01	−0.06	−0.02	+0.08	+0.01
1.00	−0.04	−0.10	−0.17	+0.31	0.00
2.00	−0.08	−0.13	−0.08	+0.30	+0.01
Range	0.16	0.14	0.20	0.42	

Sum of ranges 0.92

workers in a chemical development lab wish to learn the corrosion rate of chlorides in nitric acid on a new alloy.

The range of interest for chloride concentration (as HCl) is from 0.01 to 2.0% by weight and for nitric acid concentration it's from 10 to 50% by weight.

Since they want to learn the effect of chloride and acid concentrations both individually and in combinations they use a factorial design—performing the various treatment combinations at random. Temperature is kept constant and sample pieces, picked at random, are completely submerged in the solution. After a suitable time they remove the samples and compare the corrosion rates at equilibrium. Results are above.

There appears to be a drop in the corrosion rate at 15-25% nitric acid. The question is: Is it significant? In addition, the corrosion rate appears to climb as the chlorides content is increased. Again there's the question of whether or not this is meaningful.

Deviations from the row mean are calculated and totaled. The total of the deviations for each row should not be more than ±0.02 (See page 196 for the method of calculating this). This provides a check on the arithmetic.

Next they enter Table III with the number of ranges equal to 4, and the number of observations per range equal to 6, to get factors 1.13 and 0.26. These are multiplied by the sum of ranges, 0.92, giving 1.04 and 0.24.

The former is the allowance for the column (acid concentration) totals, while 0.24 is the allowance for the row (chloride concentration) means.

Specifically, if two acid concentration totals differ by more than the allowance, 1.04, they may safely conclude that the two differ in their effect on rate. And, if two chloride concentrations differ by more than 0.24, they can conclude that these differ in their effect on the corrosion rate.

Thus, concentrations 10, 15 and 25% acid do not differ significantly in their effect on corrosion rate, while the 50% acid rate does differ from the 15% and 25% acid rates, but not from the 10% acid rate.

Therefore, the indicated "dip" in corrosion rates at 15-25% nitric acid concentration is not confirmed. It is likely to be due to sample variability, the inevitable "errors" in measurements, etc. However, an increase in acid content from 25% to 50% does significantly increase the corrosion rate.

Consider the effect of varying chloride concentration. The means for chloride concentrations 0% and 0.20% differ by 0.33 which is greater than the allowed 0.24. Differences between 0%, 0.01% and 0.05% are not significant. But the mean for 2.00% concentration differs from the mean for 0.05% concentration by more than the allowed 0.24—hence, they can safely conclude that a Cl concentration of 2.00% does give a higher corrosion rate than concentrations of 0.05% or less. With a really high chloride concentration, the corrosion rate is high.

Note that the % HNO_3 means aren't needed to compare the effects of the various percentages of HNO_3. However, if we wish to compare the % HNO_3 means, we simply divide 1.04, the allowance for column totals, by 6 to obtain the corresponding allowance for column means, 0.17.

These three techniques—completely randomized design, randomized blocks design, and factorial design—have a wide application in chemical engineering practice. They can be used to obtain reliable information vital to solving a host of problems.

The method of statistical analysis given here has been considerably simplified so you can put it to immediate use without further study.

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CE REFRESHER

Chemical Engineering Fundamentals

Why Kinetics for Reactor Design?

T. E. CORRIGAN and E. F. YOUNG, Olin Mathieson Chemical Corp., Brandenburg, Ky.

The safety meeting had just ended. Some of the boys hung around for a couple of drags before heading back to the "No Smoking" area. The bull session went something like this (We all know that whenever chemical engineers have a bull session they never talk about women but only about engineering):

"I see they're giving some night courses in chemical engineering at the University. Gonna take anything, Joe?"

"Heck, no! What can those longhairs at the U. teach me? Most of them haven't even set foot in a chemical plant. I've been building and running plants for five years."

"They're offering Chemical Kinetics—II, 3 credits, 7 to 9 P.M. That ought to be interesting."

"Chemical kinetics! What's that good for? If they'd cut out all that theoretical ivory tower stuff and teach something practical, they'd be a lot better off. What good would kinetics ever do me?"

"By the way, Joe, how's the new isomer reactor working? You started up last week, didn't you?"

"We shut down again yesterday. It doesn't work. Reactor's too small—only about 60% of design capacity."

"Not enough prepilot data?"

"Plenty of data. Don't know what's wrong. We had 28 runs in the 5-gallon reactor to get the reaction rate and time. Then we scaled up to the big tower. But it didn't seem to work. We had to shut down."

Yes, Joe says that kinetics is high falootin', ivory tower stuff. What good would kinetics be to a practical engineer like himself? But let's look at Joe's problem.

His assignment was to design the reactor for the small isomer unit. He set up and executed an experimental program in a small batch reactor to obtain reaction time and product distribution. Then he used these figures directly to design a continuous baffled-tank reactor.

When the unit went on stream it had neither the capacity nor the product distribution obtained in the experimental work. Why? Because Joe, giving no thought to the kinetics of the process, didn't consider the backmixing effect when he used batch data to design a continuous reactor.

Kinetics could have helped Joe, the development engineer.

Helps Process Engineers Also

John took a last drag on his cigarette, punched out the butt and headed back to the process area. John was a process engineer in Production Dept. B. He knew every pipe and tank in the place and could run the unit with his eyes shut. There wasn't a problem in the area that John couldn't solve. Except one, that is—to increase the capacity of Number 2 reactor.

"Wonder what would be the effect of doubling the feed ratio and cutting my recycle? How is a guy supposed to guess at stuff like that without any data?"

Well, what could John do without data? There surely wasn't time for a research program on the subject.

One thing he could do would be to try a little kinetics. From his daily production records he could get a fairly good estimate of his reactor capacity and the product distribution at the conditions at which he was operating the unit. He could use these data to estimate his rate constants and from them he could estimate the results at the proposed conditions.

Mechanism Affects Reactor Design

Jim works in the research lab. His specialty is process and engineering research. He knows less about which end of a pipewrench to hold than Joe or John but knows more about which end of an integral sign to hold. Or, at least, he likes to think he does.

Jim has been working on a liquid phase noncatalytic reaction for the last two months. He thought he had all the answers—yield, product distribution, space velocity, temperature, pressure and reaction time. But now the boss wants to know if the reaction mechanism is all

$$A \rightarrow R \rightarrow S \qquad (1)$$

or is the parallel reaction

$$A \rightarrow S \qquad (2)$$

also taking place? Jim doesn't see why this is important in the first place, and doesn't know how to do it, in the second place.

Kinetics can answer both of these questions for Jim. It's important to know the mechanism for reactor design since the effect of backmixing differs markedly for the two possible mechanisms.

And the same applies to his determination of the mechanism. He could use a little kinetics to help him out. He could set up two experimental reactors: one a long tubular reactor that would have essentially no backmixing; and the other could be set up as a stirred-tank reactor.

By using kinetics Jim could then see that if the reaction goes by method (2) he will get essentially the same product distribution from both reactors. But if the reaction proceeds by method (1), the product distribution from the two reactors will be considerably different.

Kinetics: A Tool, Not a Profession

The three cases above are hypothetical but they show where kinetics could be put to practical use by the development engineer, by the production engineer and by the research engineer. Kinetics is not a specialty to be used only by kineticists; it is a tool for all chemical engineers (except salesmen, perhaps).

In the previous series of your CE Refresher (*Chem. Eng.*, Aug. 1954 through July, 1955) we have tried to present some of the theoretical aspects of kinetics in as simple a manner as possible. In some instances perhaps, the approach was oversimplified.

However, in the author's mind, oversimplification is the least of many evils in a field such as kinetics which has not yet gained universal acceptance as an everyday engineering tool. When kinetics is as widely used as, for example, the McCabe-Thiele diagram, then we can put more emphasis on such aspects as the theory of absolute reaction rates.

Our greatest fault is one of omission rather than oversimplification. The section on homogeneous reactions presented the classical interpretation of the order of reaction concept but omitted many of the practical aspects of applying kinetics to homogeneous-reactor design. The section on heterogeneous reaction kinetics emphasized adsorption, reaction mechanisms and data interpretation but omitted entirely catalytic reactor design problems.

Reactor Design Series

The purpose of the series that we'll begin next month will be to rectify these omissions. Reactor design problems for both homogeneous and heterogeneous systems will be emphasized.

We'll stress particularly the effect of reactor geometry on product distribution and reaction time for various types of reactions.

The series on the application of kinetics in reactor design will be divided into these general sections:

- Discussion of the various kinds of reactors and of reacting systems which may be considered in the field of reactor designs for both homogeneous and heterogeneous systems.
- Derivation of kinetic equations and an explanation of their use in practical reactor design.
- Solution of reactor design problems for heterogeneous systems.

The second section of the proposed series will discuss in detail the solutions of the three problems discussed in the hypothetical cases above.

REACTOR DESIGN

Next month we'll begin a new series of your CE Refresher covering the process design problems of commercial reactors.

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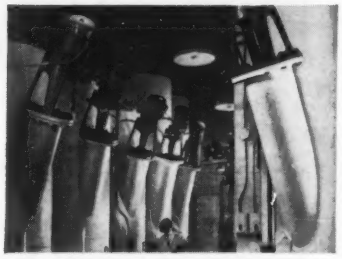

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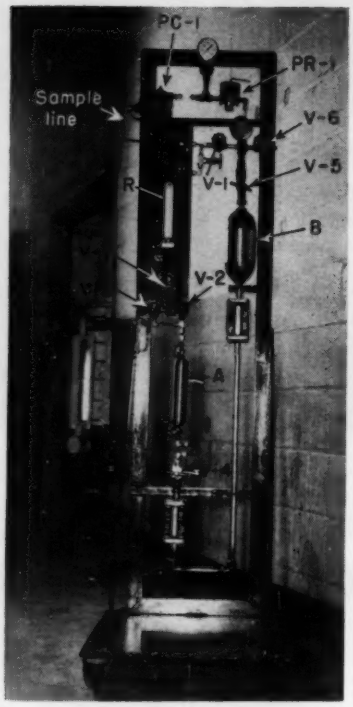

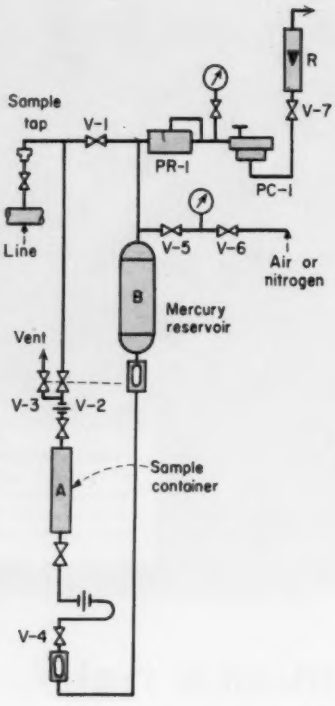

★ Winner of May Contest

Sampler for Gases at High Pressure

E. R. Hawley and Ernest Solomon

Petroleum and Chemical Research Department, M. W. Kellogg Co., Jersey City, N. J.

In high-pressure pilot plant and test unit operations it is often necessary to withdraw an aliquot gas sample for subsequent analysis. The sample must be withdrawn at a measured and controlled rate to insure its being representative of the total gas stream during the test period. For convenience of handling, and since the total volume of test unit systems is usually quite small, it is desirable to minimize the volume of the sample container. The all-metal sampling system described meets these needs.

The gas sampler is illustrated in the adjoining correspondingly lettered photograph and diagram. In use, the sample is collected at operating pressure by positive displacement of mercury. The rate of mercury withdrawal—and of sampling—is controlled by adjusting the rate at which air, nitrogen, or some other suitable gas available at the operating pressure of the system, is bled from the sampler. The volume of gas discharged from the apparatus is measured at atmospheric pressure. Loss of mercury inventory from the sampler, and exposure of the unit operators and analysts to mercury, is negligible.

The apparatus and its operation will be clear from the sketch. Reservoir *B* contains sufficient mercury to fill sample bomb *A* and the auxiliary lines to the level indicated by the dashed horizontal line. The volume of *B* is about twice that required to contain all the mercury.

To operate, make sure that valves V-1 and V-2 are closed and V-3 is open. Then allow mercury to flow from reservoir *B* into sample bomb *A* until the mercury level reaches valve V-3. Approach of the mercury to valve V-3 is estimated from the level of mercury in the sight-glass below the reservoir. No mercury need be discharged through valve V-3. Then, with valve V-3 closed, admit compressed air, nitrogen, or other suitable gas,

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★ **Winner of June Contest:**

Easily Made Triangles Help Replot Your Data Graphs to Various Scales

Winner of the June Plant Notebook Contest, this article has earned for H. J. Ramey, Jr., Field Research Laboratories, Magnolia Petroleum Co., Dallas, Tex., a prize of $50 in cash. Often the engineer must replot a curve to a different scale on one axis, while holding the other constant. The task becomes easy using triangles as developed by Mr. Ramey.

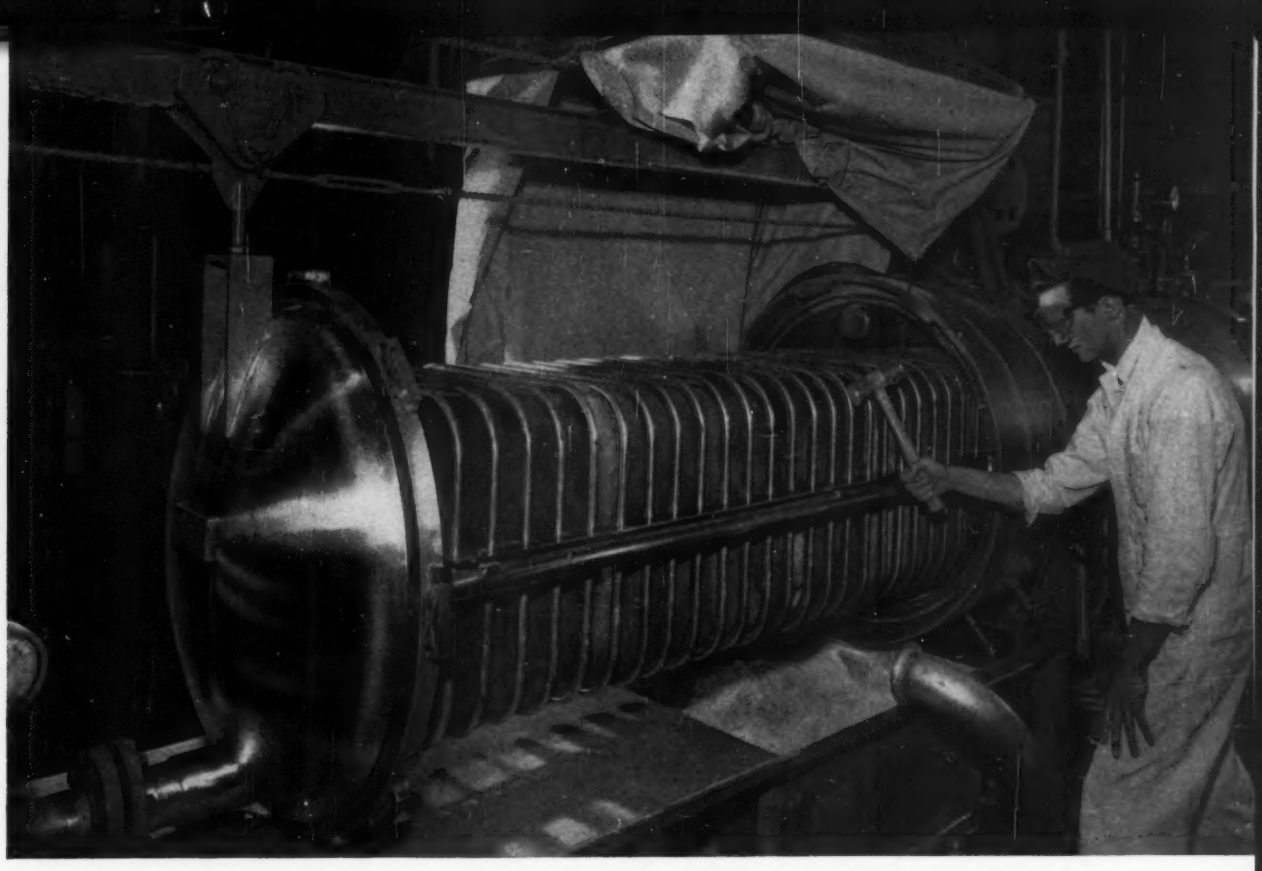
$50 PRIZE FOR A GOOD IDEA—Until further notice the Editors of *Chemical Engineering* will award $50 cash each month to the author of the best short article received that month and accepted for the Plant Notebook.

Each month's winner will be announced in the issue of the second following month, and published the third following month.

$100 ANNUAL PRIZE—At the end of each year the monthly winners will be rejudged to determine the year's best Plant Notebook article which will then be awarded an additional $100 prize.

HOW TO ENTER CONTEST—Any reader of *Chemical Engineering*, other than a McGraw-Hill employee, may submit as many entries for this contest as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable nonwinning articles will be published at regular space rates ($10 minimum).

Articles may deal with plant or production "kinks," or novel means of presenting useful data, which will interest chemical engineers. Address Plant Notebook Editor, *Chemical Engineering*, 330 West 42nd St., New York 36, N. Y.



How Norwich Pharmacal solved a separation problem

in the production of Nitrofurans

PROBLEM: Furazolidone is a nitrofuran widely used in veterinary medicine, for the control of poultry diseases. In the synthesis of furazolidone, one of the final steps involves filtering the product from the suspension. The slurry is corrosive to carbon steel. After filtration, the cake must be washed with water, then partially dried and quickly removed so it can be fed to a tray dryer.

SOLUTION: For this step Norwich Pharmacal engineers specified a Niagara Horizontal Pressure Leaf Filter with 245 square feet of surface area; type 316 stainless steel at all liquid contact points; fitted with a low-pressure steam jacket. It is equipped with a special manifold at the top for blowing in hot air.

RESULTS: Entirely satisfactory. After the furazolidone collects on the filter leaves, it is washed with water, then partially dried inside the filter with hot air at 80° C. The leaves then roll out of the filter tank on a monorail and the semi-dry cake drops off the leaves into a cart, ready for feeding to the tray-dryer. Only a few minutes are required for one man to clean the filter and ready it for the next cycle.

Niagara stands ready to cooperate with you, too, in solving *your* problems. A Niagara field engineer will gladly run preliminary tests on your material, using a laboratory size filter. Should you decide to run production scale tests in your own plant, Niagara pilot filters are available to you. Niagara engineers will design and build filters to meet your specific needs. If you wish, your installation and start-up will be supervised by an experienced Niagara engineer.

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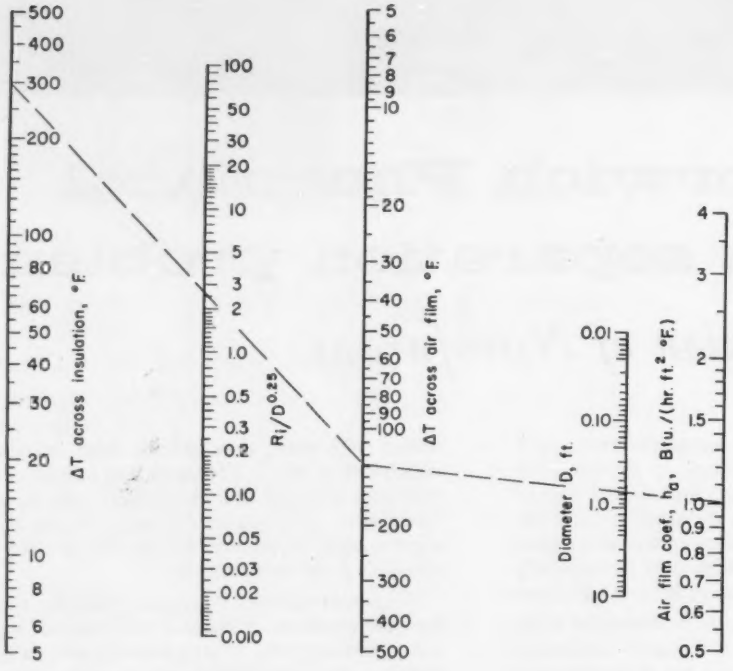
to reservoir *B* through V-6 until the pressure is slightly less than the operating pressure of the flow system. Set pressure reducer *PR-1** to hold about 50 psi. at the inlet to the differential pressure controller *PC-1**.

Slowly open the valve between the sampler and flow unit, then open valve V-1 to equalize the pressure between the mercury reservoir and sample line. Close valve V-1 and open valve V-2 above the sample bomb. Open valve V-7 and adjust the needle valve on *PC-1* to give the desired rate of gas withdrawal as indicated on rotameter *R*. Note that the gas being discharged through rotameter *R* is at atmospheric pressure, while the sample is being collected at the operating pressure of the unit.

At the end of the sampling period, close the valve between the flow unit and the sampling apparatus and valves V-2, V-4 and V-7. Drop the pressure above the mercury in the reservoir to atmospheric pressure. Slowly open valve V-4 below the sample bomb, allowing mercury to drain from the bomb until its level appears in the lower sight-glass. Close valve V-4 and the valves on each end of the sample bomb, then remove the bomb.

When sampling a gas stream at, for example, 450 psig., the volume of gas metered through the rotameter is 30-fold greater than the volume of gas collected. If the gas collected is largely hydrogen and the gas displaced is air, a further advantage is gained in that the rotameter reading is about 3-fold greater than if the hydrogen-rich gas had been metered. This additional advantage can be enhanced by substituting for air a gas of higher molecular weight.

* Suitable devices for these purposes include a small reducer made by Grove Regulator Co., Oakland, Calif., and a small controller made by Instruments, Inc., Tulsa, Okla.



Nomenclature

h_A	Air-film coefficient, Btu./(hr. sq. ft. °F.)
h_i	Fluid-film coefficient inside pipe, Btu./(hr. sq. ft. °F.)
T_s	Temperature of outside surface of pipe, °F.
T_a	Temperature of air, °F.
T_i	Temperature of fluid inside pipe, °F.
D_o	Outside diameter of pipe, ft.
q	Amount of heat transferred through 1 sq. ft. of outside surface, Btu./(hr. sq. ft.)
R_i	Total thermal resistance except for air-film.
Δx	Thickness, ft.
k	Thermal conductivity, Btu.-ft./(hr. sq. ft. °F.)
D_m	Log mean diameter, ft.
D_i	Inside diameter, ft.

Subscript 1 refers to pipe wall
Subscript 2 refers to insulation

Chart Finds Air-Film Coefficients

J. O. Osburn

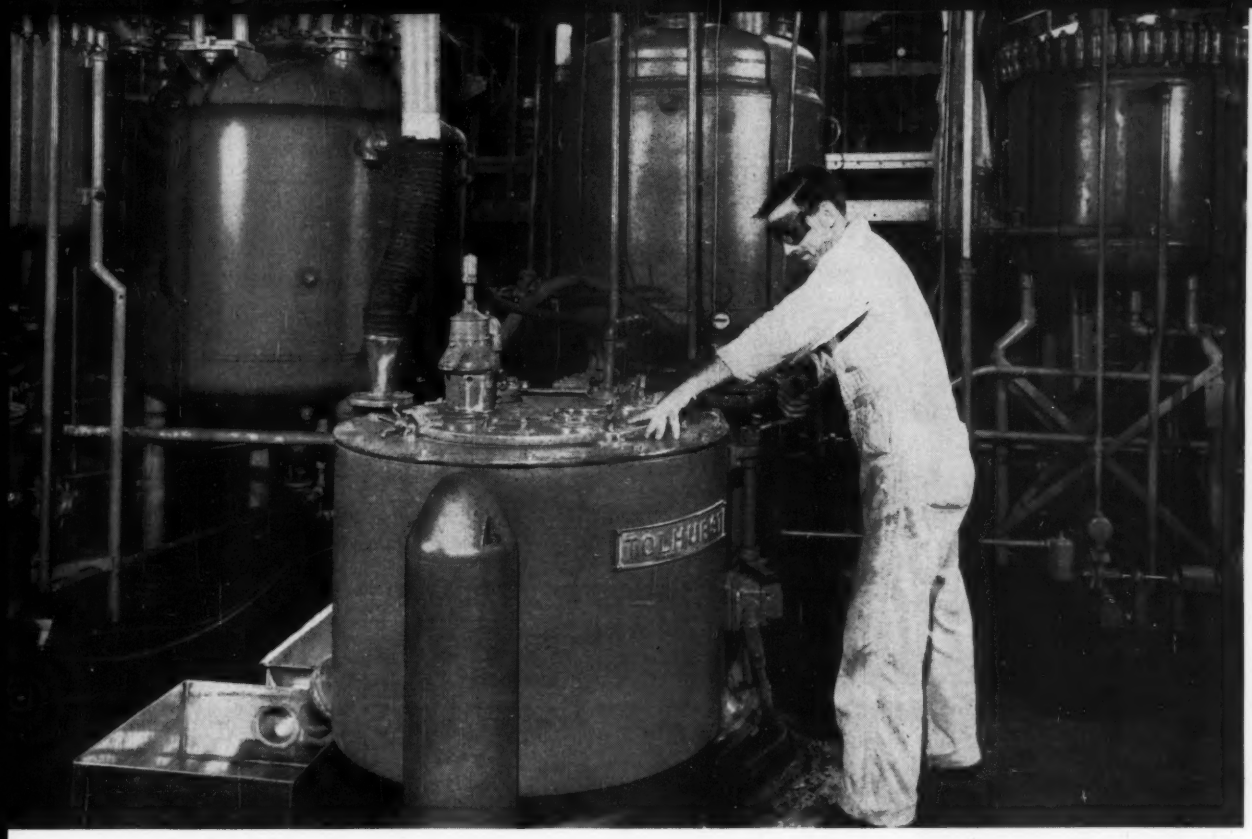
State University of Iowa, Iowa City, Iowa.

For the flow of heat by natural convection from horizontal cylinders to still air, Brown (Brown, G. G., "Unit Operations," p. 444, Wiley, New York, 1950) recommends the following equation:

$$h_A = 0.27 \left(\frac{T_s - T_a}{D_o} \right)^{0.25} \quad (1)$$

The term $(T_s - T_a)$ refers to the difference between the temperature of the surface of the cylinder and that of the air. In the usual case, the temperature of the material flowing inside the pipe is known, but that at the outside surface of the pipe is not. For uninsulated metal pipes the thermal resistances of the fluid film inside the pipe and of the pipe wall are usually negligible, and the surface temperature is essentially that of the inside of the pipe. For pipes which are poor conductors, such as glass or plastic, and for insulated pipes, this is not the case, and the surface temperature can be calculated only by trial-and-error.

The nomograph above is useful in finding the air-film coefficient in such cases. It does not eliminate the trial-and-error procedure, but makes it much easier. The derivation of the nomograph is as follows:



How Norwich Pharmacal solved a separation problem

in the production of Nitrofurans

PROBLEM: Nitrofurazone is a nitrofuran used in the treatment of surface infections in wounds, burns and surgery. In the synthesis of nitrofurazone, one of the final steps involves separating out the precipitate, a fine-grained material which does not drain readily. The slurry is corrosive to stainless steel. After separation, the product must be washed to remove acids. The product is valuable so loss must be avoided.

SOLUTION: For this step Norwich Pharmacal engineers specified a 30″ Tolhurst Center-Slung® Centrifugal with rubber-lined case and rubber-covered basket, 2-speed explosion-proof motor and fume-tight cover with feed and spray pipes. A filter bag is used.

RESULTS: Entirely satisfactory. Slurry is fed at low speed to facilitate drainage. High speed is used for extracting. After centrifuging, the nitrofurazone is washed (at low speed) with treated water introduced through the spray pipe. The slurry does not affect the rubber lining. The filter bag inside the basket prevents loss of product.

Tolhurst engineers stand ready to cooperate with you, too, in solving *your* problems. Samples of the material you wish to process will be tested without charge in Tolhurst's laboratory. Tolhurst engineers will design and build centrifugal equipment to meet your specific needs. If you wish, your installation and start-up will be supervised by an experienced Tolhurst engineer. Field and home office engineers are always at your service.

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Specialists in Liquid–Solids Separation

The flow of heat per square foot of outside surface is written in terms of the inside resistance and driving force, and that of the air film.

$$q = \frac{T_i - T_s}{R_i} \quad (2)$$

where

$$R_i = \left(\frac{1}{h_i}\right)\left(\frac{D_o}{D_i}\right) + \left(\frac{\Delta x_1}{k_1}\right)\left(\frac{D_o}{D_{m1}}\right) + \left(\frac{\Delta x_2}{k_2}\right)\left(\frac{D_o}{D_{m2}}\right) \quad (3)$$

$$q = (T_s - T_a)(h_A) \quad (4)$$

Combining Equations (2) and (4), and writing for the air-film coefficient its value given by Equation (1),

$$q = T_i - T_s = 0.27\left(\frac{R_i}{D^{0.25}}\right)(T_s - T_a)^{1.25} \quad (5)$$

This relation is plotted in nomographic form in the left part of the chart, and Equation (1) in the right part. In the usual case, the overall temperature difference is known, and the individual temperature differences must be adjusted until their sum is equal to the overall ΔT.

The use of the nomograph is illustrated by the following problem:

A 4-in. Schedule 40 steel pipe is covered with 2 in. of insulation whose conductivity is 0.1. The steam inside the pipe is at 500°F., and the condensing-film coefficient is 1,500. The air is at 80°F. Calculate the air-film coefficient, and the overall coefficient of heat transfer.

Solution—For 4-in. steel pipe, the inside diameter is 4.03 in. and the outside diameter is 4.50 in. The thickness of the steel is 0.237 in. Therefore, over the insulation the outside diameter is 4.50 + 2(2.00), or 8.50 in.

The log mean diameter is 6.29 in. and the conductivity of steel is 26. Hence:

$$R_i = \left(\frac{1}{h_i}\right)\left(\frac{D_o}{D_i}\right) + \left[\left(\frac{\Delta x}{k}\right)\left(\frac{D_o}{D_m}\right)\right]_{\text{steel}} + \left[\left(\frac{\Delta x}{k}\right)\left(\frac{D_o}{D_m}\right)\right]_{\text{insulation}}$$

$$= \left(\frac{1}{1{,}500}\right)\left(\frac{8.50}{4.03}\right) + \frac{(0.237)(8.50)}{(12)(26)(4.27)} + \frac{(2)(8.50)}{(12)(0.1)(6.29)}$$

$$= 0.0014 + 0.0015 + 2.25 \approx 2.25$$

$$D^{0.25} = (8.50/12)^{0.25} = 0.917$$

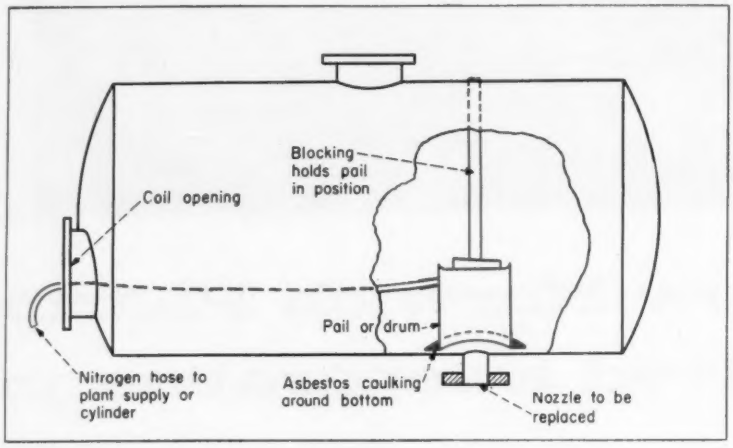
$$R_i/D^{0.25} = 2.25/0.917 = 2.45$$

$$D = 8.50/12 = 0.708 \text{ ft.}$$

The total ΔT is 500—80, or 420° F.

Locate the point on the $R_i/D^{0.25}$ scale representing 2.45. Draw lines through this point intersecting the ΔT scales. Add the ΔT's until a pair is found whose sum equals 420. The dotted line on the diagram shows this pair to be 130° F. and 290° F. From the intersection of this line with the ΔT (air-film), draw a line through $D = 0.708$. This intersects the h_A scale at 1.0. Therefore, the air-film coefficient is 1.0.

The total resistance is therefore 1/1.0 + 2.25 = 3.25, and the overall coefficient is the reciprocal of the resistance, or 1/3.25 = 0.308.


Blocking holds pail in position
Coil opening
Pail or drum
Nitrogen hose to plant supply or cylinder
Asbestos caulking around bottom
Nozzle to be replaced

Welding Repair to Process Vessel

Donald H. Lawrence

General Foreman, ADN Plant, E. I. du Pont de Nemours & Co., Niagara Falls, N. Y.

Sometimes process vessels acquire an inside coating of hard, tarry substances which are almost impossible to remove without a great deal of time-consuming labor. Yet, such materials will burn if a welding repair has to be made to the vessel.

Under such circumstances I use a safe and simple method in which the area that must be heated is blanketed in nitrogen. First, the vessel must be properly washed and steamed, then tested for opening. All manhole covers and steam coil assemblies are then removed. After further testing for entering, we follow the standard procedure for entering closed vessels while installing the container for the nitrogen atmosphere.

This latter is a small drum or 5-gal. open-top pail to which a ¾-in. nipple is welded. Following the safe entering procedure we wedge the pail in place with the open end over the nozzle or spot to be welded, then caulk around the edges of the pail with asbestos rope or paper, or asbestos mud. A nitrogen hose, from the plant supply or cylinder, is connected to the nipple and a fair bleed of nitrogen is turned on. The nitrogen will escape through the nozzle, or around the caulking at the edge of the

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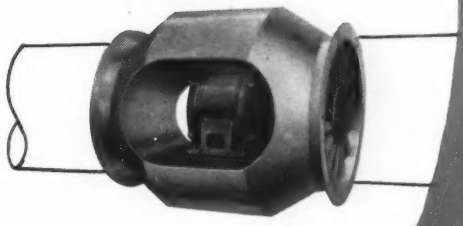

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pail, but will keep an atmosphere within the pail which cannot support combustion.

Before welding we wet down the inside of the vessel thoroughly with water and re-check for the presence of an explosive mixture. Only then is the repair made. Afterward we shut down the nitrogen and thoroughly air the vessel to purge the nitrogen before entering.

Boiling Out Stills for Water-Immiscible Liquids

Marvin B. Schaffer

Chemical Engineer, Samuel Feltman Ammunition Laboratories, Picatinny Arsenal, Dover, N. J.

Preparing distilling units for maintenance shut-downs often means a time-consuming boil-out period, with loss in valuable production and manpower. This is particularly true when welding is required on columns for the processing of flammable solvents.

The common procedure is to install a live steam line to the base of the reboiler and conduct a steam distillation at high reflux ratio to recover the residual solvents in the system. It is not unusual for such an operation to consume 8 hr., depending on the size of the unit and the level of fire protection and solvent recovery deemed necessary.

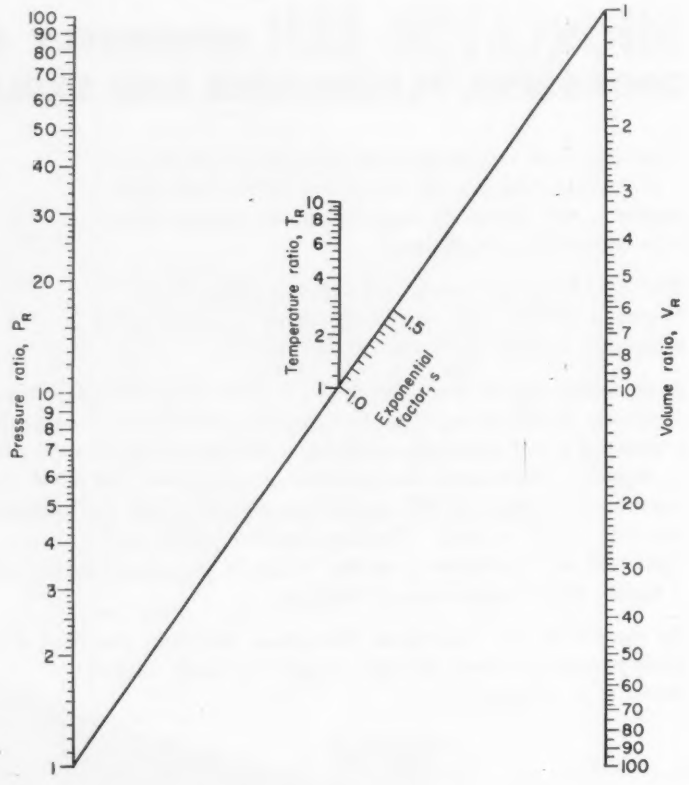
Some bubble-cap columns are equipped with "weep holes" to give more complete drainage and reduce the boil-out period. However, this simple innovation requires thoughtful design layout if it is to effect complete drainage on shut-down, without reducing the stability and efficiency of the plate during operation.

Columns which do not contain weep holes, but which normally process solvents immiscible with water—for example, benzene, toluene and the like—can often be made ready for repairs with a saving of valuable hours by a water wash preceding the boil-out. Here the procedure is simply to run water into the condenser vent (or the constant level tank vent), and pump the water via the reflux system to the top of the tower. Being heavier, the water will displace oil on each succeeding plate until all the solvent has been washed to the bottom of the reboiler.

The further addition of water can usually be stopped when an interface appears in the sight glass of the reboiler flash tank.

Following this, it is simply necessary to drain water from the bottom of the reboiler until oil appears, then pump the residual oil to a process tank. What oil will be left will be negligible in amount —only that small percentage that is miscible with water. This can be removed by a second wash-down, or by a greatly reduced boil-out period.

In actual operation of a 30-in. column containing 36 bubble plates, the boil-out was reduced from the normal 5-7 hr. to about 1½ hr. using the procedure described here.



Compression-Expansion Chart for Gases

Antonio Di Lorenzo

Chemical Engineer, Brooklyn, N. Y.

Problems involving pressure-temperature-volume relations of gases can be time consuming, especially if the computations are made without a log-log slide rule. The accompanying nomograph is useful in such cases, the solutions requiring only a few simple arithmetic steps.

The nomograph solves the double equation $P_R = V_R' = T_R^{(s/s-1)}$ where P_R is the pressure ratio, V_R the volume ratio, T_R the temperature ratio, and s is the exponen-

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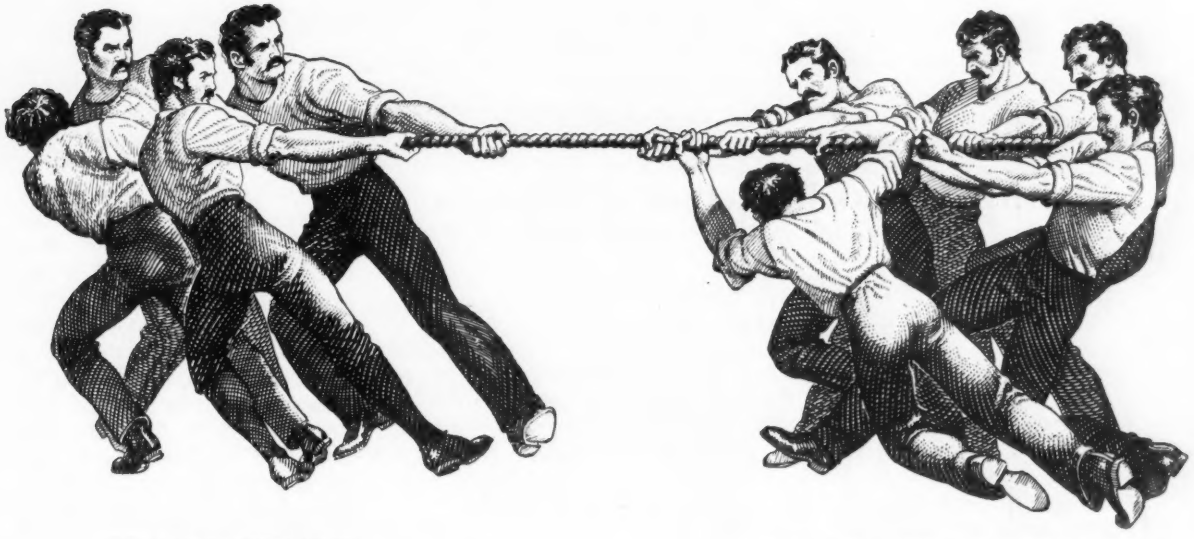

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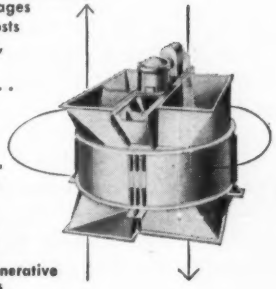

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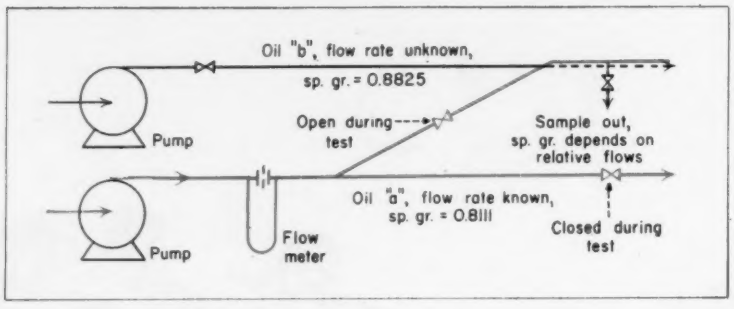
tial constant. Knowing any two values in the above equations, the other two can be found by drawing a single straight line through the known points on the nomograph.

When an expansion is isothermal, $s = 1$, $T_R = 1$, and $P_R = V_R$. The chart is designed to handle any value of s between the isothermal and the adiabatic conditions, where $s = 1.4$.

Example—If air is compressed adiabatically from 1 std. atm. at 70° F., to 75 psia., how much free air will be required to give 1,000 cu. ft. at the compressed condition? If we assume no heat loss, what will the final temperature be? Here, $P_R = 75/14.7 = 5.1$, and $s = 1.4$. From the chart, $V_R = 3.25$ and $T_R = 1.6$. Therefore, the volume of free air = $1{,}000 \times 3.25 = 3{,}250$ cu. ft., and the final temperature = $(460 + 70) \times 1.6 = 848°$ F. abs., or 388° F.


Oil "b", flow rate unknown,
sp. gr. = 0.8825
Pump
Open during test
Sample out, sp. gr. depends on relative flows
Oil "a", flow rate known, sp. gr. = 0.8111
Closed during test
Pump
Flow meter

Measuring Flows by Method of Mixtures

Thomas Garcia B.

Chief Chemist, Laboratories TUGN, Petroleos Mexicanos Poza Rica, Ver., Mexico.

A method sometimes used in estimating the flow of rivers is to dump in a known weight of some measurable material at a point upstream, then analyze for its concentration downstream after complete mixing has taken place.

The same general idea can be used to determine unknown flows of process materials, using the more convenient bases of volumetric flow rate, and specific gravity (rather than actual analysis and concentration), provided that the materials mixed are sufficiently similar that the laws of perfect solution can be assumed to hold. If the materials are of this character, for example, two petroleum oils, then it is very nearly true that there will be no volume change on mixing, and hence the density of the mixture can be calculated from the known volumes and densities of the components. Substituting for density the specific gravities at 60/60 °F. will introduce very little error. In this case:

$$\frac{1}{S_m} = \frac{W_a}{100\,S_a} + \frac{W_b}{100\,S_b}$$

where S is specific gravity, W is weight percent, and the subscripts are: a = component a, b = component b, and m = the mixture of a and b. Note that the assumption of perfect solution does not hold for concentrated solutions of electrolytes and the method should not be used for them.

Of course, the easiest way to measure flow of a process stream is to use a flow meter. But there may be instances where there is no suitable way to install a meter in the line. In such a case the method of mixtures may be applicable, as the following discussion will show.

Let us assume that crude oil *b* is flowing through the upper line in the sketch and that its flow rate is unknown. Its specific gravity S_b at 60/60 °F. is 0.8825. We have another measurable flow of a second oil *a* of specific gravity $S_a = 0.8111$ which can be injected into the first line so that a mixture of the two oils is produced. This flow might be injected at a known rate by means of a positive-displacement proportioning pump; or it might be injected as shown in the lower line of the sketch by a centrifugal pump discharging through a flow meter. After mixture, the combined flow is sampled and its specific gravity measured.

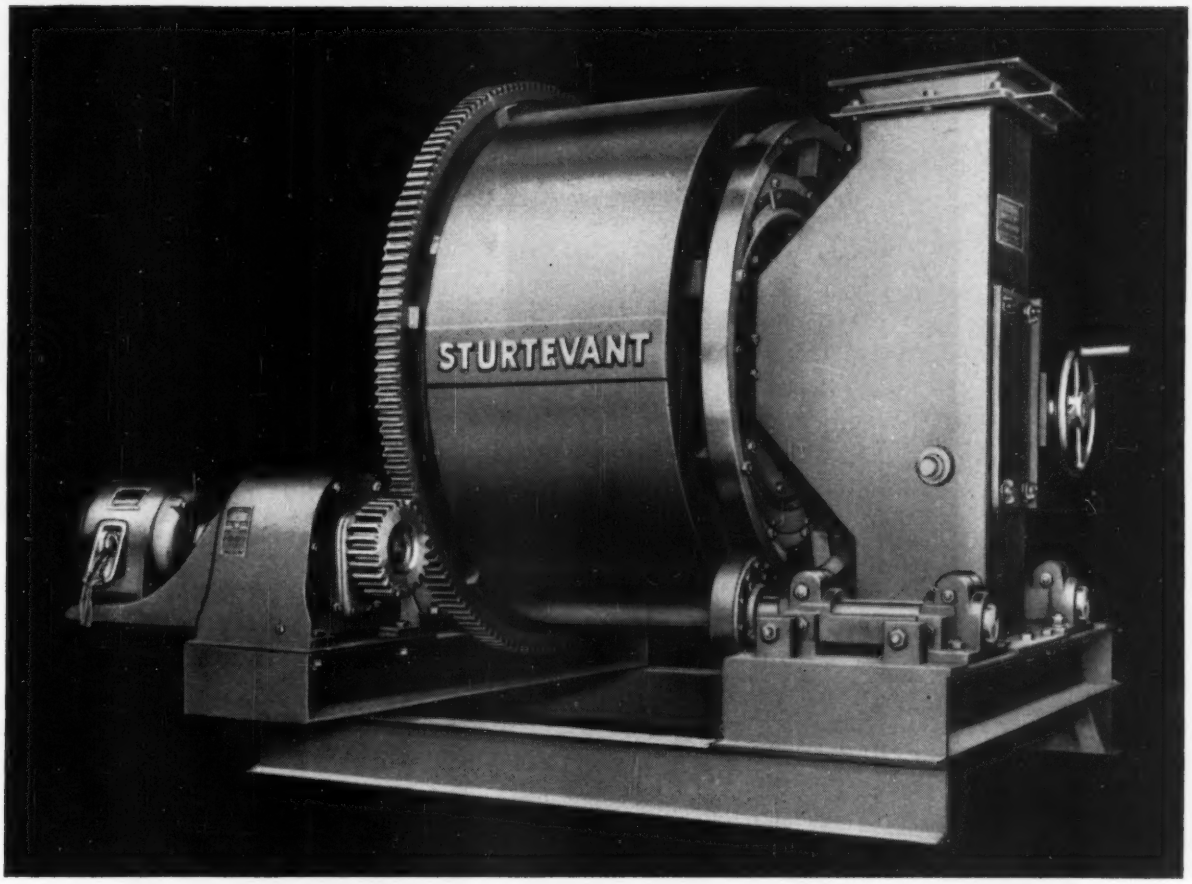
Assume that the specific gravity of the mixture is found to be 0.8804. Then from the equation:

$$\frac{1}{0.8804} = \frac{W_a}{100 \times 0.8111} + \frac{W_b}{100 \times 0.8825}$$

and by calculation we find that the flow rate ratio of *b* to *a* is 1 to 0.03. Therefore, if the flow of *a* is 5 gpm., then the flow of *b* is 166.7 gpm.

If the problem is to be able to set the flow rate of *b* to certain desired quantities, rather than simply to find what the flow rate is, then the easiest way is to calculate a table of mixture specific gravities for various ratios of *b* to *a*. The accompanying table has been worked out for *b*/*a* ratios from 1/0.01 to 1/0.10. With the table it is then possible easily to vary the flow of *b* until the desired mixture specific gravity is obtained. For example, if the flow rate of *a* is 5 gpm. and we want to adjust the flow of *b* to 100 gpm., then the ratio *b*/*a* will be 1/0.05 and the table shows that the mixture gravity must be 0.8791 if the specific gravities of the components are as shown.

Flow Ratio b/a	Mixture Specific Gravity
Pure *b*	0.8825
1/0.01	0.8817
1/0.02	0.8811
1/0.03	0.8804
1/0.04	0.8797
1/0.05	0.8791
1/0.06	0.8784
1/0.07	0.8778
1/0.08	0.8772
1/0.09	0.8766
1/0.10	0.8760
Pure *a*	0.8111



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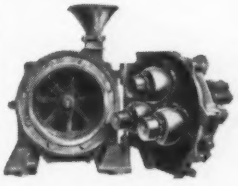

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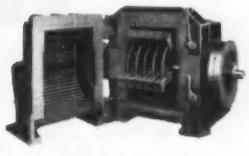

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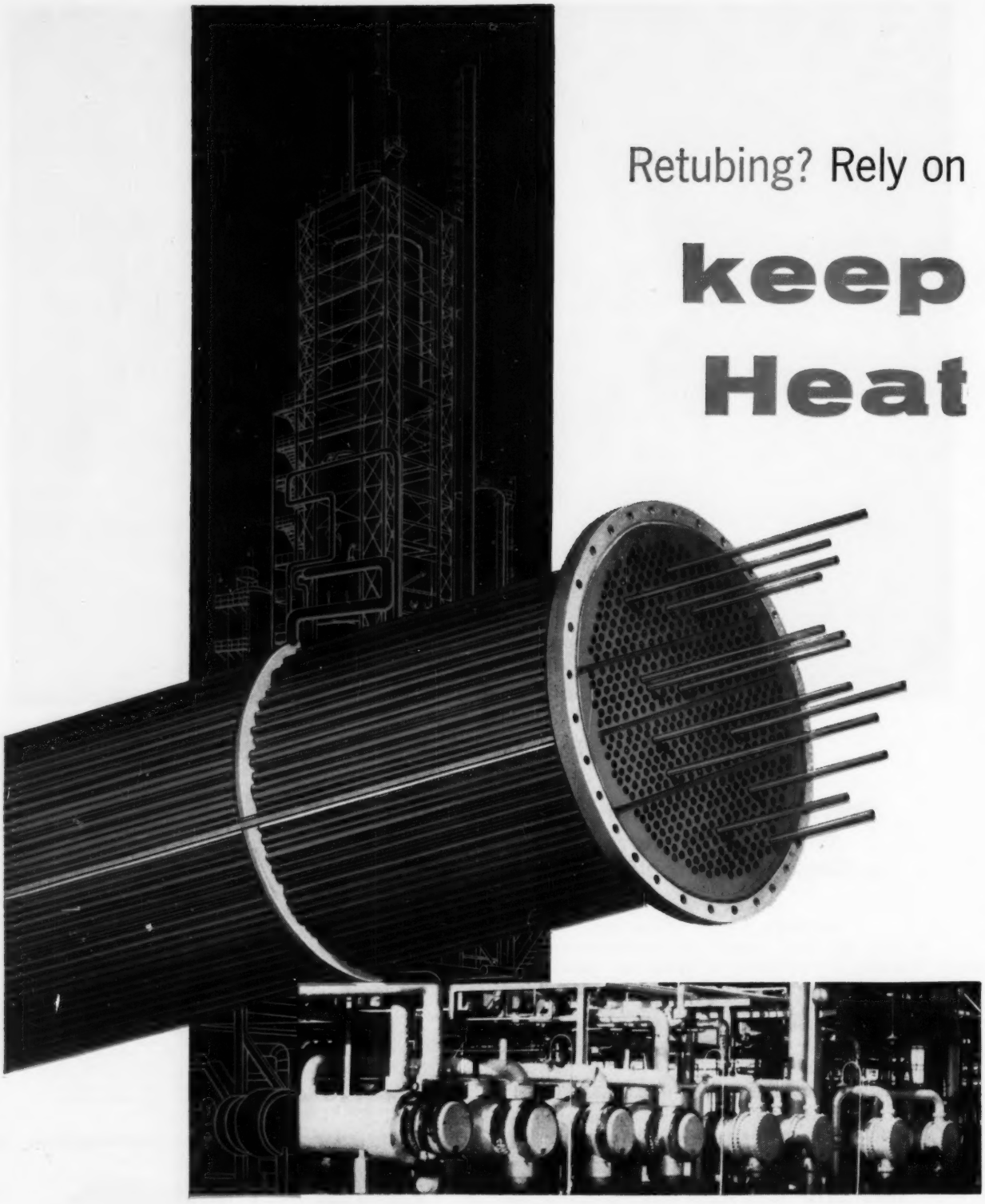

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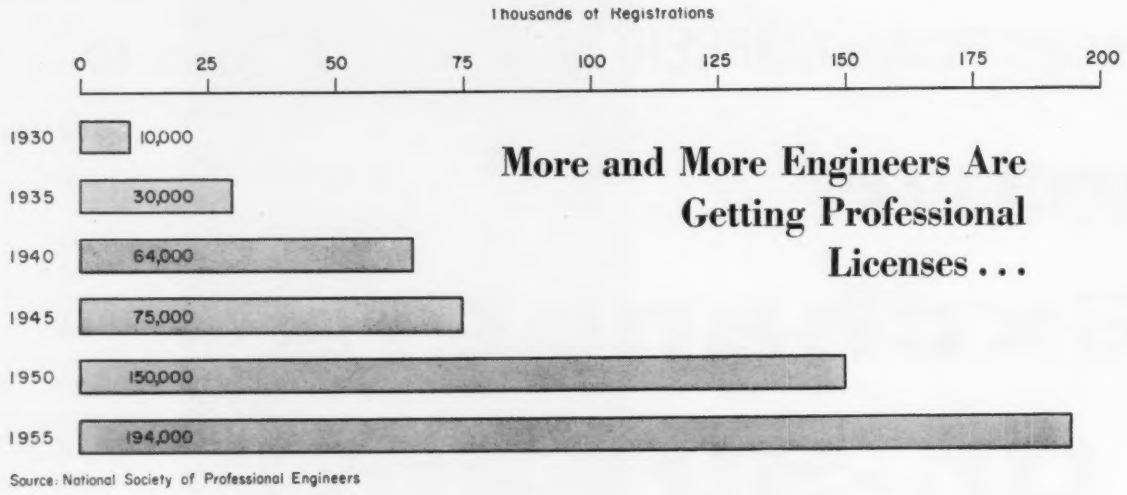
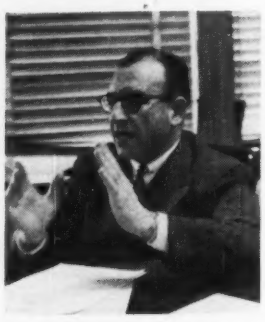


Are You Ready for Professional Registration?

"You are," says John D. Constance, a professional engineer with 13 years experience in helping men prepare for and pass state exams, "if you can prove that you have the required knowledge and experience." To get a clearer picture of what's needed—and how to get it—we asked Mr. Constance the following questions. His answers will give you an insight on how licensing boards view your background.



Mr. Constance, since most chemical engineers hold positions which do not require a professional license, why should a chemical engineer bother with registration?

Because registration is a legally recognized testimony of competence it protects the engineer and it protects any who use his services. Setting minimum standards for the professional weeds out incompetents and undesirables and shields the engineer from their unfair competition. This pays off economically as well as in recognition and protection. It also nurtures a professional outlook which invariably brings a long-term gain.

Further, since it protects the user of the engineer's services, a license is necessary for any engineer who would offer his services to the general public. And it is looked on as highly desirable by employers. In harder times this could spell the difference between having a job and not.

Then why aren't more chemical engineers licensed?

Although nearly 195,000 of some 600,000 engineers are now licensed, almost a third of the profession, chemical engineers as a group have offered the greatest resistance to registration. In my opinion there are two main reasons for this: Over the past 20 yr. the demand for chemical engineers has been relatively high and the supply relatively short, hence employers haven't been choosy. A degree has been and is now accepted as proof enough of competence. Secondly, individual chemical engineers have hesitated because they lacked familiarity with the registration procedure and they've had no real push to look into it.

The major resistance has come from older men who have come this far without it and can't see going to the

*In a future issue, Mr. Constance will again draw on his extensive experience in guiding and teaching license candidates and discuss in detail the various state examinations. More important, he'll tell you how to prepare for an exam, and how to avoid stumbling when taking it.—*Ed.

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trouble of getting registered now. Their influence on the younger men is tremendous.

But you know, it's a funny thing about licensing, so often it happens that the engineer who has felt no need to register for years suddenly finds himself with an opportunity to do consulting work, to testify in a court case, etc. And he also realizes that he's hampered by his lack of a license.

You never know when you're going to want it or need it so it's best to register as soon as you can. It pays off.

Then registration is more than just "desirable?"

As you can see from this graph more and more engineers and a greater percentage of all engineers are turning to registration. As licensing procedures are strengthened and simplified and as more engineers become aware of the advantages of registration and learn how to go about it the practice will become even more widespread.

Incidentally, doing the studying and getting the necessary experience to gain a license helps a man to be a better engineer.

How, then, does the engineer go about registering?

The step-by-step procedure for securing a P. E. license is this:

• Write the secretary of your state board of examiners for application forms and a copy of the state registration law.

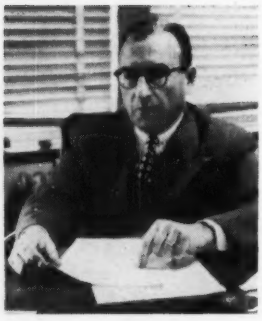
• Check the requirements listed in the law.

• Fill in the forms and obtain the required references.

• Return the application with the fee (usually $20 to $25).

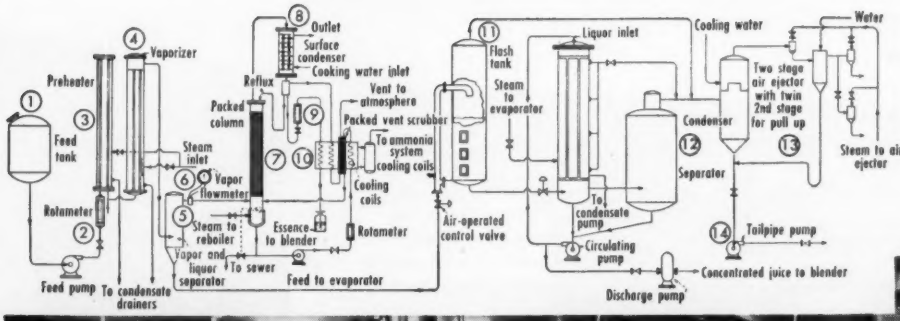
• Await the board's action. This can take some time. One state is flooded with over 2,000 applications per year.

• Follow the board's instructions. It's likely that you'll be directed to take all or part of the examination but occasionally a man is directed to appear before the board for a personal interview on his background

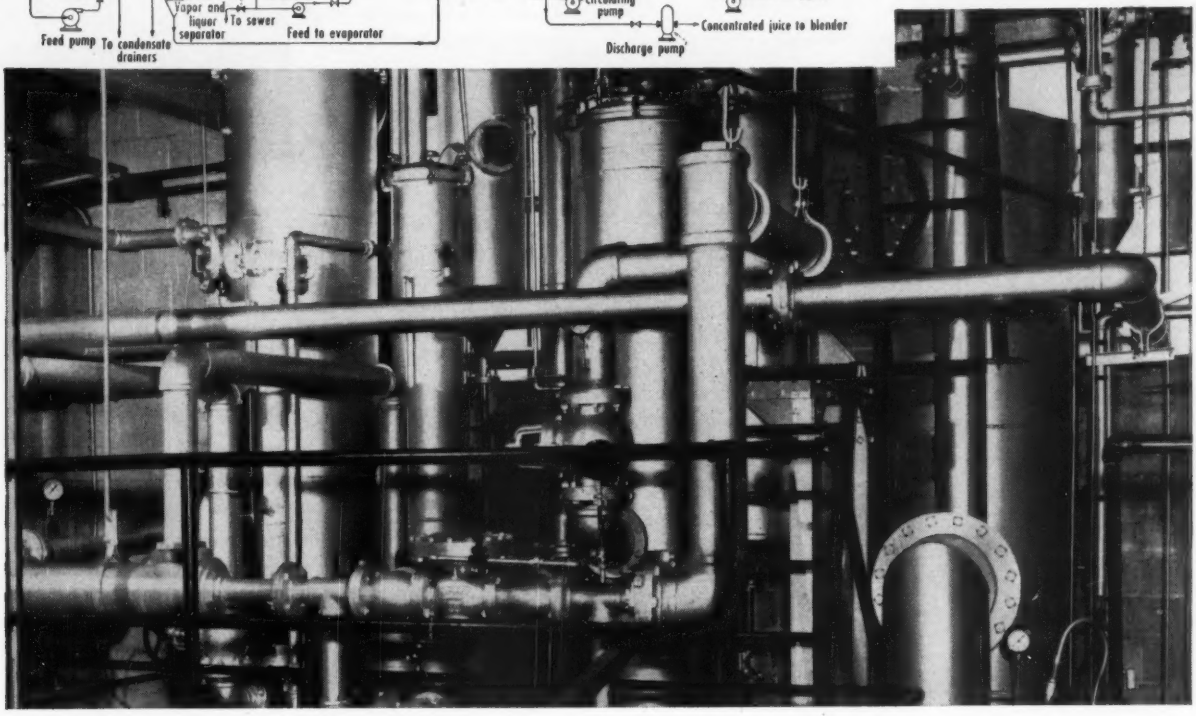


"The number of years of 'qualifying' experience a man is considered to have rarely equal his calendar years of experience."

These Applicants . . .	With Approved Experience of . . .	Can Qualify for . . .
Graduates of accredited engineering schools	Less than 4 yr.	A preliminary or Engineer-in-Training examination and EIT certification
	4 yr.	The full examination and full professional licensing
	15 yr.	Licensing by endorsement, without written examination (if special requirements set by the state board are met)
Graduates of other engineering schools	Same as above, plus added time as determined by the state board of examiners	Same as above
Non-graduates	8 yr.	A preliminary or Engineer-in-Training Examination and EIT certification
	12 yr.	The full examination and full professional licensing
	25 yr.	Licensing by endorsement, without written examination (if special requirements set by the state board are met)
Non graduates with partial educational credit from an accredited engineering school	Same as above, less credit for education as determined by the state board of examiners	Same as above



● A Buflovak De-Esterizer is used in combination with a Buflovak Low-Temperature Down-Flow Evaporator in the systems for producing Keystone concentrated grape juice.



To concentrate *heat-sensitive* grape juice without loss of flavor, Keystone selected

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Tests proved that processing methods used for frozen orange juice concentrates could not be economically applied to concentrating grape juice without loss of flavor and aroma. The addition of raw juice "cut-back" to restore aroma and flavor proved to be unattractive economically.

Keystone Cooperative Grape Juice Association solved the problem with a Buflovak De-Esterizing System and a Buflovak Single-Effect, High Vacuum, Low Temperature Downflow Evaporator. Fragrant, volatile aromatics are first stripped from the raw juice and collected at a concentration of 100-150 fold. This essence is then returned to the finished juice after it is concentrated, giving it all its original fresh, full-bodied flavor.

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and experience. Boards will waive all or parts of the examination depending on the qualifications of the applicant.

• Await the results of the exam or interview. Notification generally takes four to six months. If you pass, your certificate will be sent you soon after.

What are the requirements for registration?

There are seven general requirements, the details of which vary from state to state.

• Age–Minimum age for licensing is 25. To obtain an Engineer-in-Training certificate (EIT) the applicant must be 21.

• Citizenship–Applicant must hold United States citizenship.

• Graduation–Applicant must hold a high school diploma.

• Degree–An engineering degree from an accredited institution or the equivalent in practical experience is needed. The board has the last word on whether a man's experience is equivalent to a college degree. Graduates of nonaccredited schools must also have an added number of years of board-approved experience.

• Experience–Evidence of sufficient "qualifying" experience as of the date of application must be presented.

• Character–References (usually three) attesting to the applicant's integrity are needed.

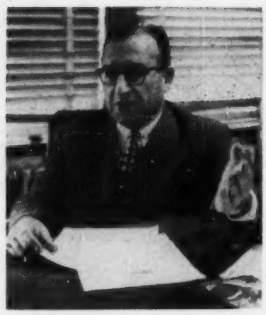
• Examination–Unless waived by the board, the applicant must pass all parts of the professional examination given by the state.

What do you mean by "qualifying" experience?

The National Council of State Boards of Engineering Examiners defines it as: "The legal minimum number of years of creative engineering work requiring the application of the engineering sciences to the investigation, planning, design and construction of engineering works. It is not merely the laying out of details of designs, nor the mere performance of engineering calculation, writing specifications or making tests. It is rather a combination of these things plus the exercise of sound judgment, taking into account economic and social factors, in arriving at decisions and giving advice to the client or employer, the soundness of which has been demonstrated in actual practice."

Most boards insist that the experience be broad in scope and of such nature as to have developed and matured the applicant's knowledge and judgment. It can be in research, design or the supervision of construction of machines, structures or processes.

"In those states where he can, the young engineer should take the examinations for an Engineer-in-Training certificate as soon as possible. It can be a big help to him."



"State examining boards usually give broad, diversified experience more weight than narrow specialization."

States usually require about four years of qualifying experience. These are rarely equal to the number of calendar years of experience. This frequently proves a big disappointment to many men who are qualified in all other respects.

Are not salaries and job titles good criteria for determining whether or not one has this experience?

Definitely not, some draftsmen or plant foremen doing highgrade, but still subprofessional, work made good salaries. Some well paid engineers do work that could readily be handled by a nonengineer. The boards insist on engineering work of a responsible nature not routine activities.

What distinguishes routine from responsibility?

Simple operating experience or running off calculations which can be made by people with no engineering training or "handbook engineering" such as might be done by a well trained draftsman are looked on as routine activities by the boards. Most application forms ask the engineer to list the jobs in which he was "in responsible charge." This means in charge of men or of work for which the engineer assumed responsibility and which he carried through with a minimum of supervision.

Though more or less objective standards have been set up, in many cases, as you can see, the question of responsibility becomes a matter of opinion. The state board has the last word in every case. But the National Council of State Boards designated the following types of work as fitting into the category of professional experience.

• Design, specification or supervision of construction of equipment for chemical manufacture, processing plants, pilot plants.

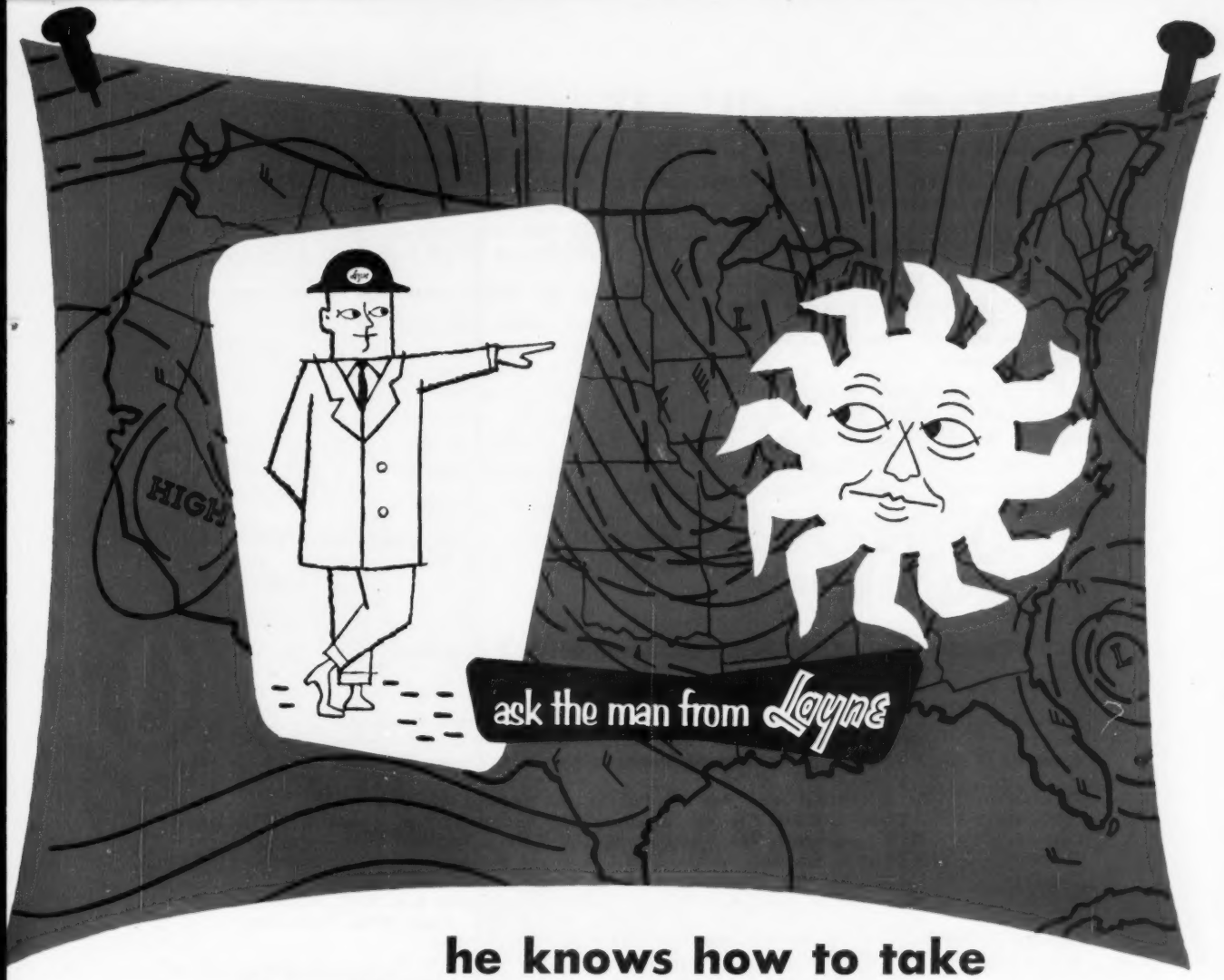
• Research on physical properties, reactions, processes, unit operations, markets.

• Development of processes, plants, products.

• Operation of pilot plants, product testing operations, technical service.

• Consulting, appraising and evaluating production operations, economic studies, patent activities.

• Teaching at college level, full time.



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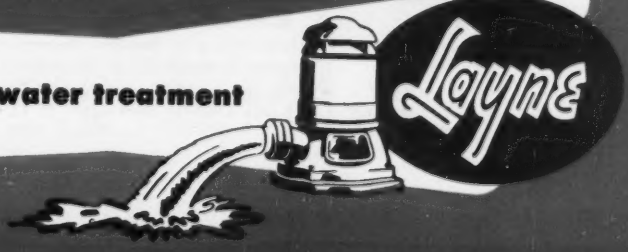

How about work in sales?

Boards regard sales engineering as professional work only if the responsibilities call for the same scientific background as a design job. The work must involve designing or adapting equipment or processes and require decisions based upon engineering fundamentals as in design or process engineering.

How can the engineer tailor his experience to meet the board's approval?

For the newly graduated engineer some routine work is unavoidable, and it may even be desirable. But to obtain the proper amount of qualifying experience he should seek the widest possible responsibility. Further, boards tend to value experience of a broad, diversified nature higher than more specialized activities. In those states where he can, he should take the written examinations to qualify for an Engineer-in-Training certificate as soon after graduation as possible. By doing so, he gets over this hurdle while the subjects are fresh in his mind. Later he need only demonstrate to the examining board that he has gotten the proper experience and he will be licensed.

Are any "helps" available to the engineer?

Yes, indeed. The secretary of the state examining board can furnish a list of courses and literature which should be helpful to the engineer. A number of companies, especially the larger ones, provide courses or opportunities to take courses which lead to licensing. Finally, a number of schools and private tutors conduct courses preparing men for the registration exam.

How much does it cost?

A refresher course averages about $100 plus books and requires about four or five months of study.

How to Contact Your State Board of Engineering Examiners

If you live in . . .	Write to . . .
Alabama	Clifton C. Cobb, Executive Secretary, 609 Monroe Street, Montgomery
Alaska	Linn A. Forrest, Secretary, Box 251, Juneau
Arizona	Mrs. Rayma Neeb, Executive Secretary, Room 319, Arizona Title Bldg., 128 N. 1st Street, Phoenix
Arkansas	V. E. Scott, Secretary, Box 175, Pulaski Hts. Station, Little Rock
California	William A. White, Executive Secretary, 529 Business & Professional Bldg., Sacramento
Colorado	M. E. Langsteiner, Asst. Secretary, 20 Capitol Bldg., Denver
Connecticut	William K. Simpson, Secretary, 30 Oak Street, Hartford 6
Delaware	Carmen J. Facciolo, Secretary, 2808 N. Van Buren St., Wilmington
Dist. of Columbia	Mrs. Lacey W. Coad, Asst. Secretary, 1740 Massachusetts Ave., N.W., Washington 6
Florida	Mrs. Ann P. Clover, Executive Secretary, 408 John F. Seagle Bldg., Gainesville
Georgia	R. C. Coleman, Joint Secretary, 111 State Capitol, Atlanta
Hawaii	Wm. C. Furer, Asst. Secretary, 1909 Aleo Place, Honolulu 14
Idaho	S. M. Barton, Asst. Secretary, 623½ Main St., Boise
Illinois	Frederic B. Selcke, Supt. of Registration, State House, Springfield
Indiana	Ferdinand Jehle, Secretary, 230 State Capitol, Indianapolis
Iowa	W. G. Cunningham, Secretary, State Capitol Bldg., Des Moines 19
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Puerto Rico	Joaquin Mercado-Cruz, Secretary, P. O. Box 9156, Santurce
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South Carolina	T. Keith Legare, Secretary, P. O. Drawer 1404, Columbia

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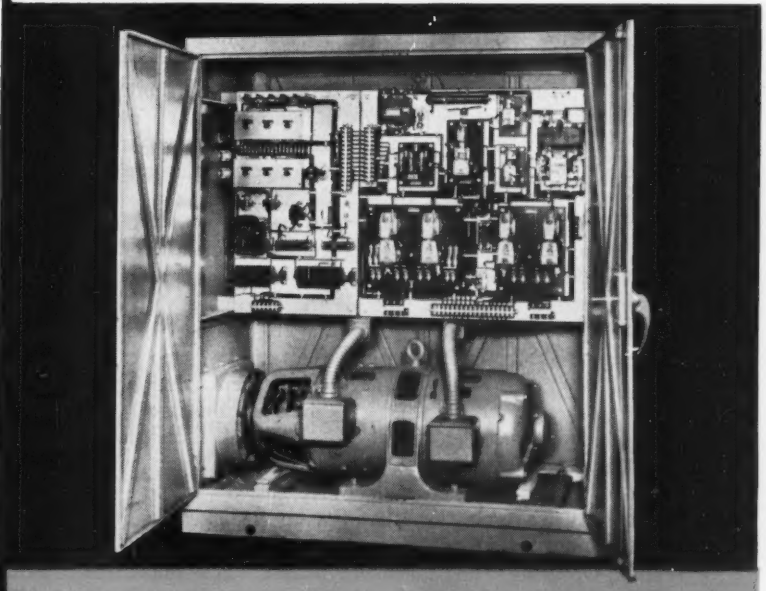

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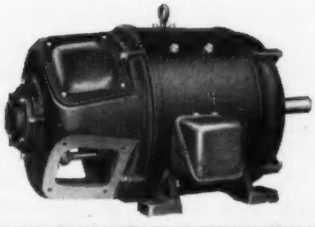

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Tennessee	Granbery Jackson, Jr., Secretary, 503 Nashville Trust Bldg., Nashville 3
Texas	Carl L. Svensen, Executive Secretary, 308 W. 15th Street, Austin 1
Utah	Frank E. Lees, Director, 324 State Capitol Bldg., Salt Lake City
Vermont	Walter D. Emerson, Secretary, c/o Norwich Univ., Northfield
Virginia	Turner N. Burton, Secretary, P. O. Box 1-X, Richmond
Washington	Edw. C. Dohm, Secretary, Dept. of Licenses, Professional Div., Transportation Bldg., Olympia
West Virginia	Robert Williamson, Jr., Secretary, 301 Morrison Bldg., Charleston
Wisconsin	W. A. Piper, Secretary, 1140 State Office Bldg., Madison 2
Wyoming	Mrs. Wilma H. Lang, Asst. Secretary, 201 State Capitol Bldg., Cheyenne

Engineer Shortage: True or False

Is there really a shortage of engineers or is talk of scarcity overdone. Here's the picture.

Is there is or is there ain't an engineer shortage? Whatever the answer, there's certainly no shortage of experts on the subject.

From the sheer tonnage of printed matter we've seen, it would seem that nearly every shade of opinion has been aired. That's why the promise of facts instead of opinions is as welcome as a temperature-tumbling shower in the midst of a heat wave.

▶ **Facts Coming**—The National Science Foundation has sponsored a recently-completed Bureau of Labor Statistics study of the shortages of scientific and engineering personnel in industrial research and development. A report on the BLS survey is set for midsummer release.

In addition, NSF has announced the initiation and the continuation of a number of studies of the supply of engineers and scientists, as well as the start of a National Bureau of Economic Research inquiry into the methods for determining the supply and demand of specialized personnel. From the latter it hopes to come up with better criteria for evaluating the supply-demand situation.

▶ **Warring Opinions**—The BLS survey was scarcely completed before it had stirred a flurry of conflicting interpretations. BLS field men personally contacted officials in about 200 big companies—employing a substantial proportion of all industrial research and development men.

About half reported shortages and about half say they feel no manpower pinch. Roughly a third of the entire group report "major" shortages and some reveal that they've been forced to curtail projected increases in R&D because of a lack of qualified men.

Some have dramatized the shortage reports and cite the survey as proof of a general lack of engineers and scientists. While others grasp the fact that about half of the companies surveyed say they've experienced no shortage, and only a minority claim a major shortage, and offer this as evidence that shortage reports have been greatly exaggerated.

▶ **Qualitative Indicators**—Other commentators also cite such qualitative indicators as inches of "Situation Open" advertising vs. inches of "Situation Wanted" ads and the employer-applicant ratio at employment clearing houses as proof of a shortage.

Both of these indicators have flaws. But, along with the easily recognized record demand for new graduates, they do sketch the outlines of the supply-demand picture. It's hoped that NSF's current studies will fill in the details.

▶ **Toothache-Like**—What do those outlines reveal? This engineer-scientist shortage is something like a toothache, painful where it occurs but relatively localized.

There is a real, and acute, shortage of young engineers. Blame it on the low depression birthrate, blame it on a government report of a few years back which took a pessimistic view of the future job outlook for technical men, blame it on a lack of preparation for engineering school on the part of high school graduates, blame it on what you will, young engineers are in short supply and they will be for some time to come.

In addition, the demand is high. Employers like them. Generally they're well-prepared, they're adaptable and—though the ante's risen—they'll work for less money.

Specialists in certain areas are also in short supply. Companies draw their employment specs pretty tightly these days. They know just what kind of a background they're looking for in a man. Sometimes they get him sometimes they don't. If they don't it's fashionable to blame "the shortage."

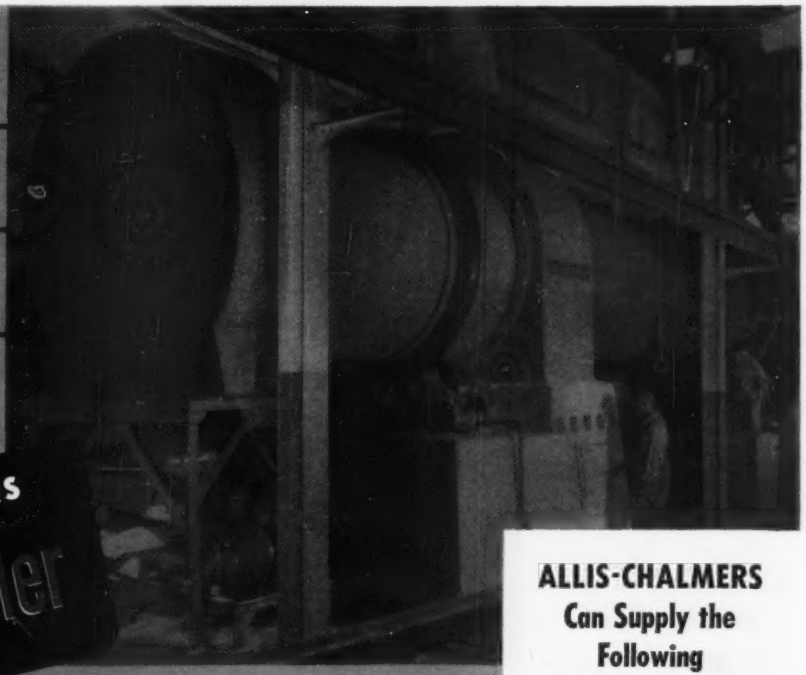
▶ **Shortages Are Specific**—Ask any company about it's over-all manpower needs and you'll be told it wants better qualified, better trained personnel. But who doesn't? Question a number of companies more closely and you'll soon conclude that engineers are wanted—but not just any engineers.

Except for the 20-yr. olds, engineer and scientist shortages are specific in kind and locale. Certain categories are short in certain areas—with no clear over-all pattern.

If you're looking for another job, you'll probably find it., But you may have to hunt for it. And if you think a new job will pay you much more than you're making now, you may be disappointed.

Does 4 Big Jobs—

- CRYSTALLIZES
- DRIES
- ANNEALS
- COOLS



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  - Rotary Dryer
  - Tube Dryer
  - Ribbon Flight Dryer
  - Double Drum Dryer
  - Rotary Steam Dryer
- **Cooling**
  - Air-Quenching Cooler
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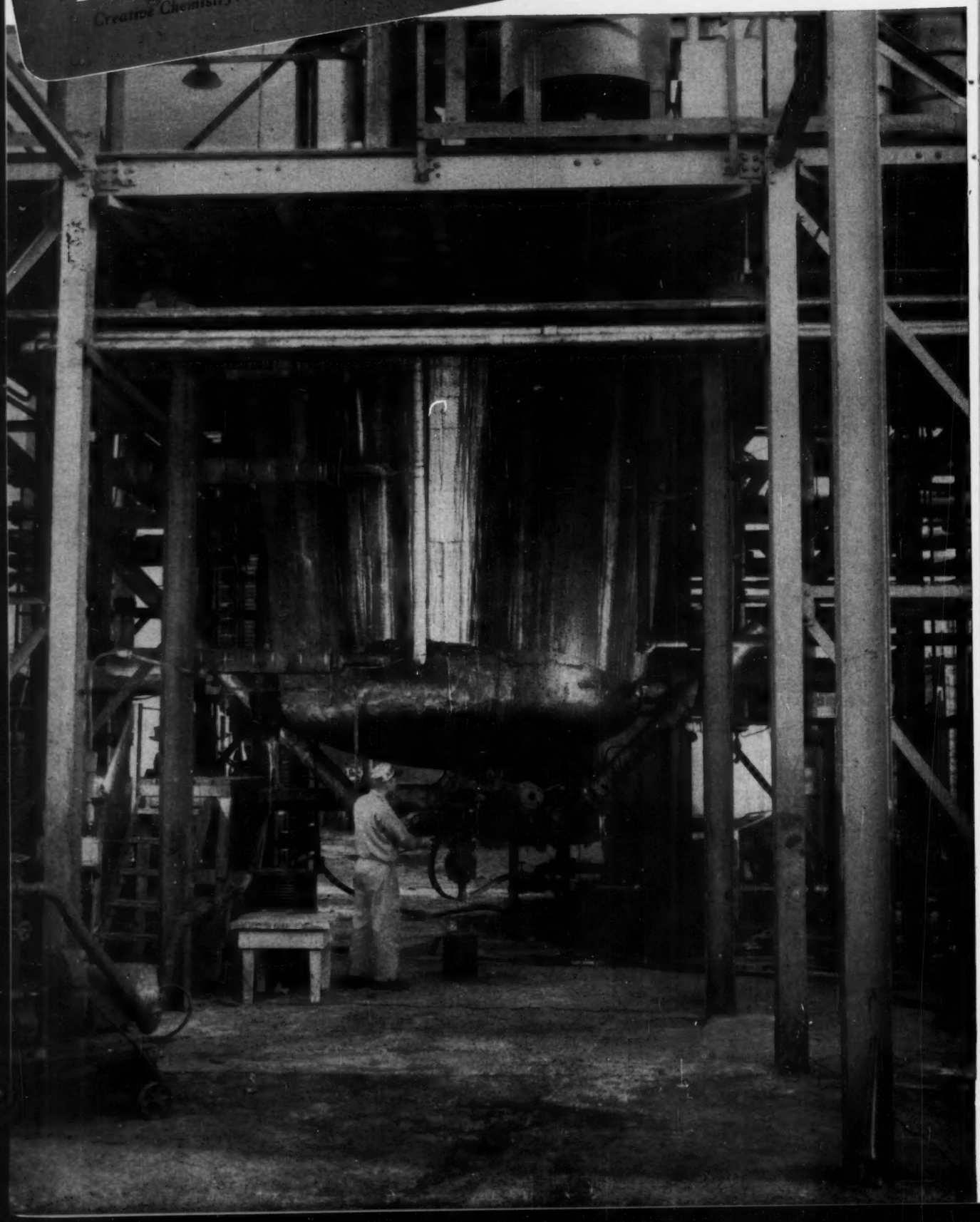
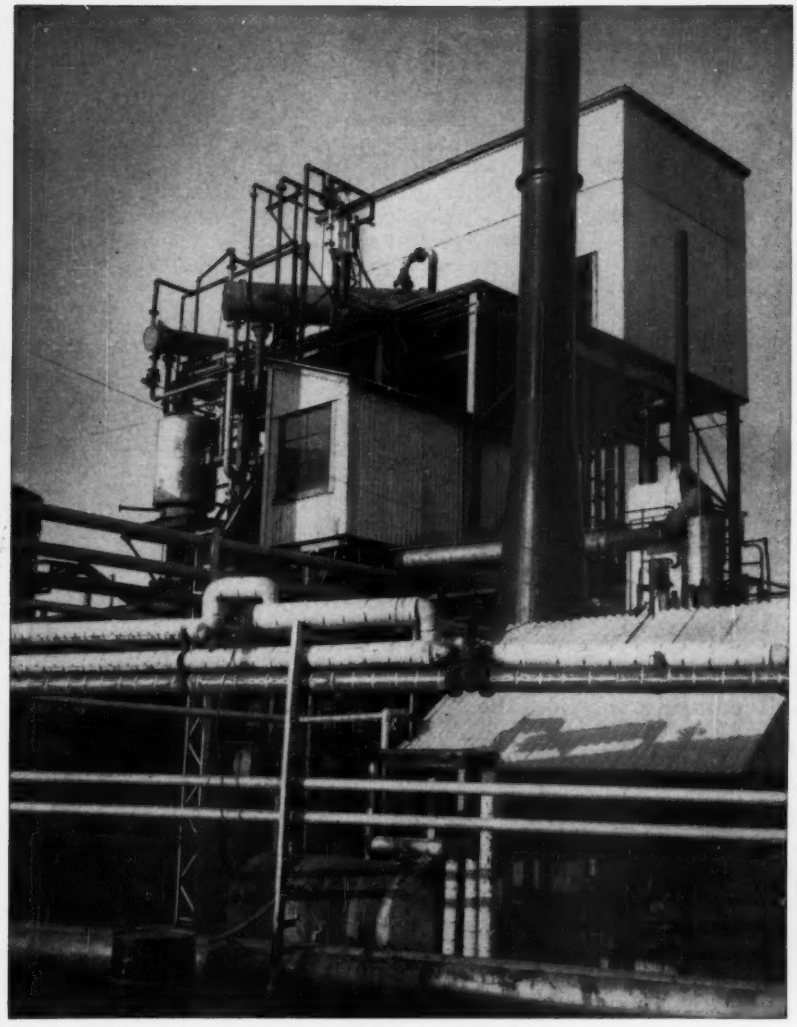


USES STAINLESS STEEL to maintain purity and top quality



7800-gallon Stainless Steel reactor at Reichhold Chemicals, Inc., Elizabeth, N. J., is housed in this structure. Two Stainless Steel heat exchangers atop the building and much Stainless Steel piping serve it.

Another view of the 7800-gallon reactor. It is in service 12-20 hours a day, 5 days a week. The reactor and piping is of special design, detailed and fabricated by Steel Alloy & Tank Company, Newark, N. J.

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Steel Structures Painting Council

	Project	Status
1. Methods	To review the art of cleaning and painting steel structures through literature surveys, conferences and other means and to determine and outline the best methods developed up to the present time.	Completed (Vol. I, Steel Structures Painting Manual)
2. Specs	To issue, if found feasible, a code or specification covering practical and economical methods of surface preparation and painting steel structures based on the present knowledge of the membership of the Council.	Completed (Vol. II, Steel Structures Painting Manual)
3. Research	To perform in its own organization, or by engaging outside individuals or organi-organizations, further research to reduce or prevent the corrosion of steel structures by surface preparation and by the application of coatings, paint and other materials and to determine the initial and annual costs thereof.	Underway
4. Advice	To issue from time to time recommendations intended to further improve and to make more effective and more economical the protection of steel structures; such recommendation to be made available to specification and code writing committees.	To be done

Needed Painting Specifications Now Available

Maintenance supervisors and design engineers need no longer laboriously detail painting jobs on the basis of information that may not be the best.

Volume II (Systems and Specifications) of the Steel Structures Painting Manual has just been published by the Steel Structures Painting Council, Pittsburgh, Pa. Combined with Volume I (Good Painting Practice) chemical engineers and other users of steel structures now have the means for easy specification in accordance with the best known practices. Specification can be done in the same easy, precise method as the steel itself is specified—by reference to a specification number.

Volume I, published in 1954, tells for various industries including the chemical industry what the critical selection factors are. Then Volume II gives detailed specs for surface preparation, pretreatment, paint application, paint and paint systems—that tell in detail how to meet the conditions prescribed in Volume I.

Much of the information contained in the chemical industry section of Volume I is based on Kenneth Tator's report on Protective Coatings, CHEMICAL ENGINEERING, Dec. 1952. This section is authored by S. W. Shepherd, materials engineer, Chemical Construction Corp., American Cyanamid Co. Both volumes are edited by Joseph Bigos, Senior Fellow, Mellon Institute, and Director of Research, Steel Structures Painting Council.

The Steel Structures Painting Council was organized in 1950 through the efforts of the American Institute of Steel Construction. It is an impartial non-profit organization supported by voluntary contributions from organizations concerned with the manufacture, specification or use of paints or other coatings for the protection of steel surfaces. These include the American Chemical Society, American Institute of Steel Construction, American Iron and Steel Institute, American Society of Civil Engineers, American Society for Testing Materials, American Zinc Institute, Federation of Paint and Varnish Production Clubs, Lead Industries Association, Mellon Institute of Industrial Research, National Association of Corrosion Engineers, National Paint, Varnish and Lacquer Association, and Steel Plate Fabricators Association among other organizations.

Volume I (Good Painting Practice) consists of 432 8½″ × 11″ pages, and Volume II (Systems & Specifications) consists of 300 8½″ × 11″ pages. Each is priced at $6 postpaid, and can be ordered from the Steel Structures Painting Council, 4400 Fifth Ave., Pittsburgh 13, Pa. See next page for contents.

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- **Order standard stock items for lower cost, faster delivery**
- **Rely on service and application recommendations from National Carbon's technical staff**

Many features recommend "Karbate" chemical process equipment for a prominent place in your plant. Its low first-cost, long service life and freedom from mechanical troubles merit your *first* consideration — not only in those highly corrosive services where nothing else will do, but *wherever* corrosion is a factor.

Write for literature!

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

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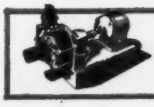
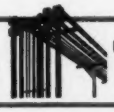
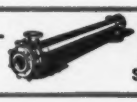
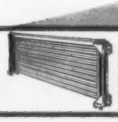

Pumps—Catalog Section S-7250


Pipe and Fittings—Catalog Section S-7000


Heat Exchangers—Catalog Sections S-6740 and S-6840


Cascade Coolers—Catalog Section S-6820

HCl Absorbers—Catalog Section S-7460

Steel Structures Painting Manual

Volume I—Good Painting Practice
- I Simplified Theory of Corrosion
- II Mechanical Surface Preparation
- III Chemical Surface Preparation
- IV Practical Aspects, Use and Application of Paints
- V Inspection
- VI Quality Control of Paints
- VII Comparative Costs
- VIII Shop Painting of Steel in Fabricating Plants
- IX Painting of Railroad Bridges and Structures
- X Painting of Highway Bridges and Structures
- XI The Painting of Steel Vessels for Salt Water Service
- XII The Painting of Steel Vessels for Fresh Water Service
- XIII The Painting of Steel Tanks
- XIV Painting of Steel in Hydraulic Structures
- XV Protection of Pipelines and Other Underground Structures
- XVI Painting of Industrial Plants
  1. Water and Sewage Works Structures
  2. Maintenance Painting of Steel and Coke Oven Plants
  3. Petroleum Refineries
  4. Chemical Plants
  5. Color in Industrial Plants
- XVII Metallizing
- XVIII Causes and Prevention of Paint Failure

Volume II—Systems and Specifications
- I Index and Guide to Recommended Painting Systems for Steel Structures (General Painting Guide for Steel Structures, Special Painting, Indexed Painting Recommendations for Steel, Painting of Non-Ferrous Building Materials)
- II Surface Preparation Guide, SSPC Surface Preparation Specs
- III Pretreatment Guide, SSPC Pretreatment Specs
- IV Paint Application Guide, SSPC Paint Application Specs
- V Paint Guide (SSPC Primers, SSPC Intermediate and Finish Paints), SSPC Paint Specs (ASTM Specs, U. S. Gov't. Specs), Special Paints and Coatings
- VI Paint System Guide (Paint Systems for Various Surface Preparation, Outline of Paint Systems and Recommended Uses), SSPC Paint System Specs

Ceramics Now Flame-Sprayed

A novel process for coating a wide variety of substances—by feeding powdered ceramic materials through a simple flame gun—has been developed at Armour Research Foundation of the Illinois Institute of Technology, Chicago, Ill.

Coatings resulting from the process—called "Flame Spray Ceramics"—are superior to those produced by the metallizing processes because of their greater resistance to heat and chemical stability.

Technique of application is similar to that required for the metallizing processes. "Flame Spray Ceramics" are sintered layers of refractory and chemically inert materials, such as aluminum oxide or zirconium oxide.

The spray coatings do not require that the metal or other base be heated unduly—as opposed to ordinary ceramic coatings which require heating both metal surface and ceramic to high temperatures.

The alumina coating is harder than tool steel and unusually adherent in thicknesses up to about 10 mils. If applied more heavily, residual stresses may cause coating failure on sudden heating or cooling.

The coating appears to be extremely effective for protecting metals, such as steel and even aluminum, against high temperature erosion such as that encountered in rocket nozzles.

Hardness of the coating suggests its use for protecting soft metals—aluminum, die-cast alloys, or mild steel, for instance—against erosion and abrasion in pump impellers and housings, fan blades and turbines, and piping subject to cavitation.

Like all sprayed coatings, "Flame Spray Ceramics" have a residual porosity of about 10 to 15% and alone do not provide perfect protection against chemical corrosion of the underlying material.

However, various additives to the two basic coatings improve their protective action, and this can be improved further by overcoating with recent ARF-developed "Solution Ceramics," or by co-spraying with soft metals.

New Aluminum-Lead Anodes

Aluminum has teamed up with lead to make possible an important new advance in the metal-plating industry. Aluminum and lead are being joined to produce aluminum-cored lead anodes for use in chromium plating and sulfuric acid electrolytic processes.

The new aluminum-lead anodes were developed by Reynolds Metals Co., Louisville, Ky., working jointly with Knapp Mills, Inc., Wilmington, Del.

Copper-cored anodes have materially improved the overall conducting efficiency. However, wherever the core became exposed through careless handling or accidental abrasion during processing, the electrolyte caused dissolution of copper. Harmful contamination of the bath resulted.

Aluminum cores offer the ideal solution. The anodes are physically strengthened, the over-all conductivity is high, and in the event of an ultimate break in the lead cladding, dissolution of aluminum will not cause harmful contamination.

"From a corrosion, abrasion and mechanical standpoint,

DURCOPUMPS

are best for the job."

Shown is a part of the Durco equipment in service at Filtrol Corporation's Vernon Chemical Plant. These pumps (and Durco Type K Valves) are handling ammonium aluminum sulfate (alum) slurries and clear liquors with small percentages of sulfuric acid. Temperatures are 150° F. to 220° F.

The Vernon Chemical Plant manufactures high purity alumina and ammonium sulfate.

Filtrol, along with other leading companies throughout the world, uses DURCO chemical service equipment for maximum service life and minimum maintenance when handling severe corrosives.

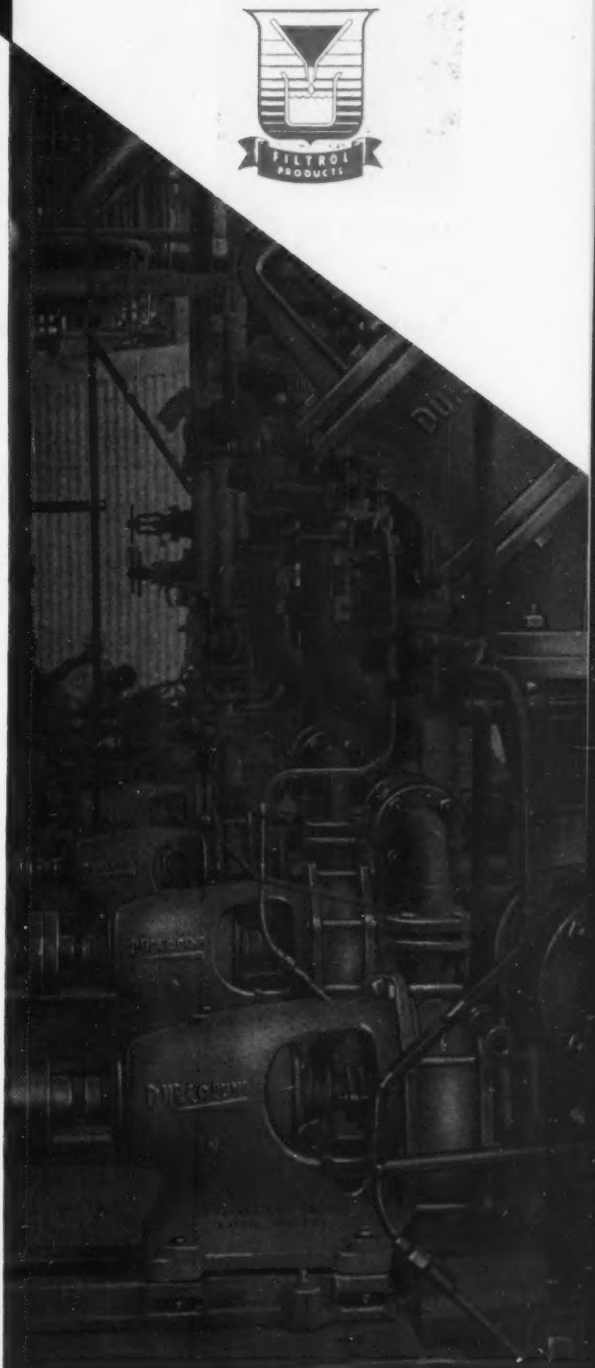
DURCO
CORROSION RESISTING ALLOYS & EQUIPMENT

THE DURIRON COMPANY, Inc.
Dayton, Ohio

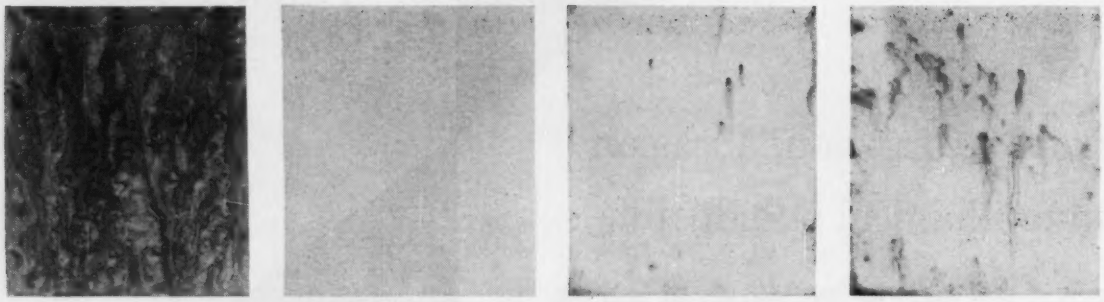
BRANCH OFFICES in Atlanta, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Philadelphia and Pittsburgh.

A **DURCO** installation at
FILTROL Corporation

Vernon Chemical Plant
Vernon, California



Series R Durcopumps are immediately available from stock at Dayton. Write for details.



SALT SPRAY TESTS, chromium directly on steel. From left: ordinary (24 hr. exposure), crack-free (24, 100, 175 hr.).

New Process Produces Crack-Free Chromium

Special chromic acid type bath with automatic regulation of catalyst concentration is key to process which, unlike conventional processes, leaves no cracks.

A new production plating process that deposits a chromium plate which provides much better resistance to corrosion than ordinary chromium directly on steel was announced recently by United Chromium, Inc., metal finishing specialists who pioneered chromium plating.

Called "Crack-Free Chromium," the new plate is deposited free of any structural imperfection that would allow corrosive materials to come in contact with the underlying surface being protected. As a result, it can be plated directly on steel, without the necessity for an undercoat of nickel or copper and nickel.

Other desirable properties of the deposit produced by the new process include low coefficient of friction, excellent adhesion, a non-galling surface and superior ductility as compared to ordinary chromium finishes. The crack-free deposit has an attractive light gray matte appearance. It can be readily buffed to a high luster.

A photo-micrograph of a cross-section of the crack-free plate shows a dense, continuous structure rather than cross sections of cracks which extend through the deposits in a similar photomicrograph of ordinary chromium plate.

Ordinary chromium deposits more than 0.0001 in. thick show cracks which permit corrosive agents to reach the underlying metal. At the decorative thicknesses, the ordinary chromium deposit contains pores, varying in number with plating conditions. As the deposit thickness increases, the number of pores decrease, but a cricked structure develops and continues regardless of the increase in thickness. Corrosive media can filter through these discontinuities in the plate to attack the base metal. To cope with this situation, chromium plating practice heretofore has called for a deposit of nickel under the chromium. The crack-free chromium process solves the problem and permits direct chromium plating on steel with assurance that it will be effectively protected against corrosion.

Crack-free chromium plating is done with a special chromic acid type bath having automatic regulation of the catalyst concentration. Standard plating equipment and procedures are used. The bath is prepared by simply dissolving the proper amount of a single compound in water. The same compound is used for maintenance. According to field reports, the bath is easy to operate and maintain. The crack-free bath has good throwing power. Its plating speed is about the same as that of ordinary chromium.

A summary of the properties claimed for the crack-free deposit follows:

1. Much better corrosion resistance than ordinary chromium plated directly on steel.
2. Remains crack-free when heated to 1,000 F. and plunged into water.
3. Softer and more ductile than ordinary chromium (500-700 Knoop as compared to 800-1000 Knoop hardness.)
4. Excellent adhesion.
5. Improved non-galling, non-seizing and leveling properties.
6. Crack-free chromium plated directly on steel can provide the same protection as the commonly used composite copper-nickel-chromium decorative finishes.

NEXT MONTH:

IRRADIATED POLYETHYLENE

See next month's Corrosion Forum article by F. J. Bockhoff and J. A. Neumann, American Agile Corp., Maple Heights, Ohio, for properties and applications of irradiated polyethylene. This new material of construction has marked advantages over conventional polyethylene, including better resistance to solvents, better temperature resistance, improved creep properties, etc. Commercial installations are now on the way.

---

to

CONTROL CORROSION

where only

MINIMUM SURFACE PREPARATION

is possible

use the

Amercoat 33 over 86 System

There is no substitute for ideal surface preparation. But every maintenance engineer is confronted with corrosion problems in locations where only minimum surface preparation is possible. The Amercoat 33/86 System is amazingly helpful in many of these cases. Here is how it works:

FIRST: apply Amercoat 86 Primer, brushing it well into the surface. This unique primer has a high tolerance for surface contamination and will adhere to many problem surfaces.

- It is both inhibitive and chemically resistant.
- It stifles underfilm corrosion and under-cutting.
- It forms a truly compatible base for vinyl topcoats, eliminating peeling and lamination.

THEN: apply Amercoat 33, the time-tested vinyl coating. Because of its high solids content, you get a thicker, heavier coating—"more mils per gallon". Applied by hot spray* or conventional spray, it takes fewer coats of Amercoat 33 to build the required film thickness.

In addition, you get more economical protection per square foot per year because Amercoat 33 is formulated specifically for maximum chemical resistance and for severe weathering conditions.

**You have the confidence of knowing that more Amercoat 33 has been applied by hot spray than any other vinyl maintenance coating! No need to stock two types of material*

Follow the line of MOST resistance

If you have a difficult corrosion problem in your plant, perhaps we can help you. Our fifteen years of specialized experience is at your service. Write for literature and the name of the trained Amercoat representative in your city.

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MOTOR FACTS ON INDUSTRY'S
MOST PREFERRED "POWER PACKAGE"

Electrical System Fact—Only the new Life-Line "A" motor gives you the unsurpassed corrosion-resistant protection of exclusive new Bondar, Bondite and Mylar* insulations.

*Du Pont Registered Trade-Mark

FACT:

The new Life-Line A is the most corrosion-resistant motor on the market

The corrosive action of chemicals takes a heavy toll on conventional motors. The new Westinghouse Life-Line® "A" motor offers more protection against corrosive atmospheres than any other motor you can buy. How?

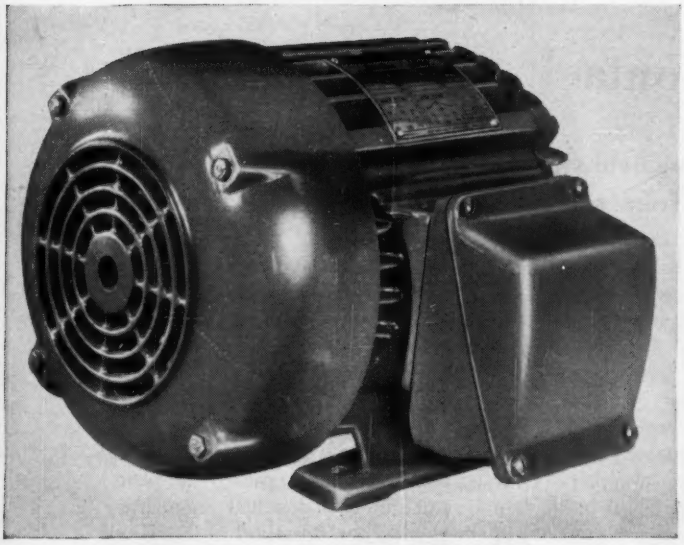
Because the combined improvements in insulation, housing and bearing design give unsurpassed protection against any contamination. It takes the right combination of such improvements in *all three systems*—electrical, mechanical and lubrication—to make the Life-Line "A" industry's most preferred power package.

Get all the facts by calling your Westinghouse sales engineer . . . *The Man With The Facts.*

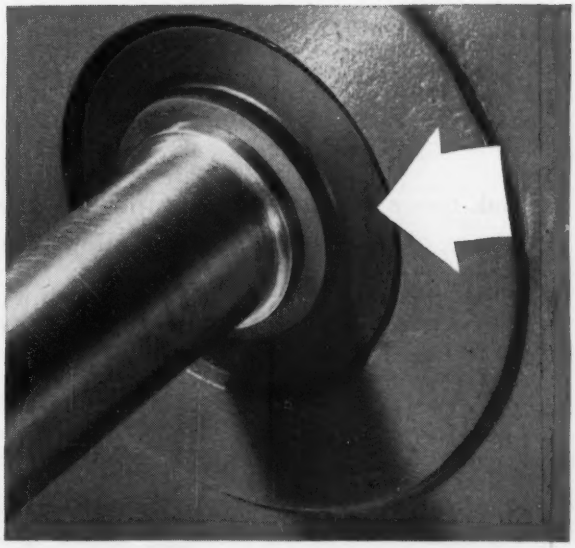
J-21881

YOU CAN BE SURE . . . IF IT'S

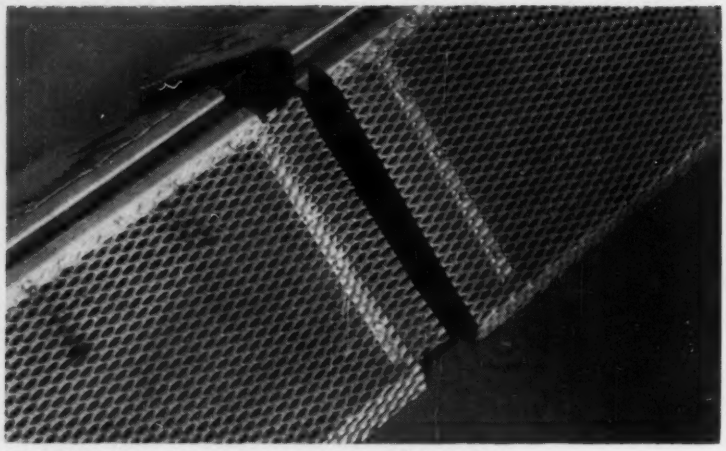
Westinghouse



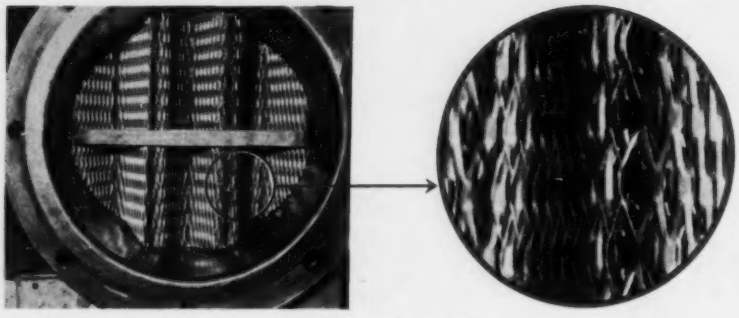
Mechanical System Fact—New cast-iron frames and brackets utilize the finest grained castings with uniformly thick wall sections precisely fitted and sealed. Molded glass plastic cooling fans on totally-enclosed types are chemically inert.



Lubrication System Fact—The new pre-lubricated Life-Line "A" bearing features a "4-way seal"—*two* seals on each side. Totally-enclosed types have additional neoprene flinger which assures bearing protection in any corrosive application.



EXPANDED metal packing on stainless steel frames . . .



STACKED in tower to form corrugated configuration . . .

Improves Gas-Liquid Contact

Latest development in a fast-moving field, Spraypak tower packing separates heavy water from ordinary water. Now it's stepping into other jobs.

No doubt about it. We must be in the golden era of devices for contacting gas with liquid. In *Chemical Engineering* alone at least six worthwhile new tower trays and packing have been described within two years.

Now just three months after telling the story of a recent English development in this field (*Chemical Engineering*, May 1955, p. 126) we can announce that this new Spraypak packing is being manufactured and sold in the United States.

Already it is operating in a large mid-western refinery to boost the capacity of an existing polymer plant stabilizer formerly equipped with bubble trays. And it is being engineered to replace 60 ft. of Raschig rings in an existing 7-ft. dia., 1,000 psi, absorber. Only 30 ft. of Spraypak will be used to provide approximately 180% of previous capacity and the same number of theoretical trays. In general Spraypak doubles output.

▶ **What It Can Do**–Ideally suited for distillation, absorption, dehydration and similar gas-liquid service, Spraypak offers:

- Capacity–double that with ordinary plates and packing.
- H. E. T. P.–less than 2 ft., substantially independent of diameter.
- Flexibility–contacts effectively down to 50% of design loading. Operates smoothly and efficiently right up to flooding point.
- Pressure drop–moderate.
- Liquid holdup–low.
- Liquid distribution–even across tower despite entrance through one pipe only.
- Cost–low.
- Installation–through manholes or top.

▶ **How It Works**–Spraypak is a cellular structure formed from strips of a special expanded metal. Openings in the expanded metal are venturi-shaped and louvered. The expanded metal sheets are mounted on interlocking frames permitting them to be installed in sections through a manhole or as a complete assembly through the top.

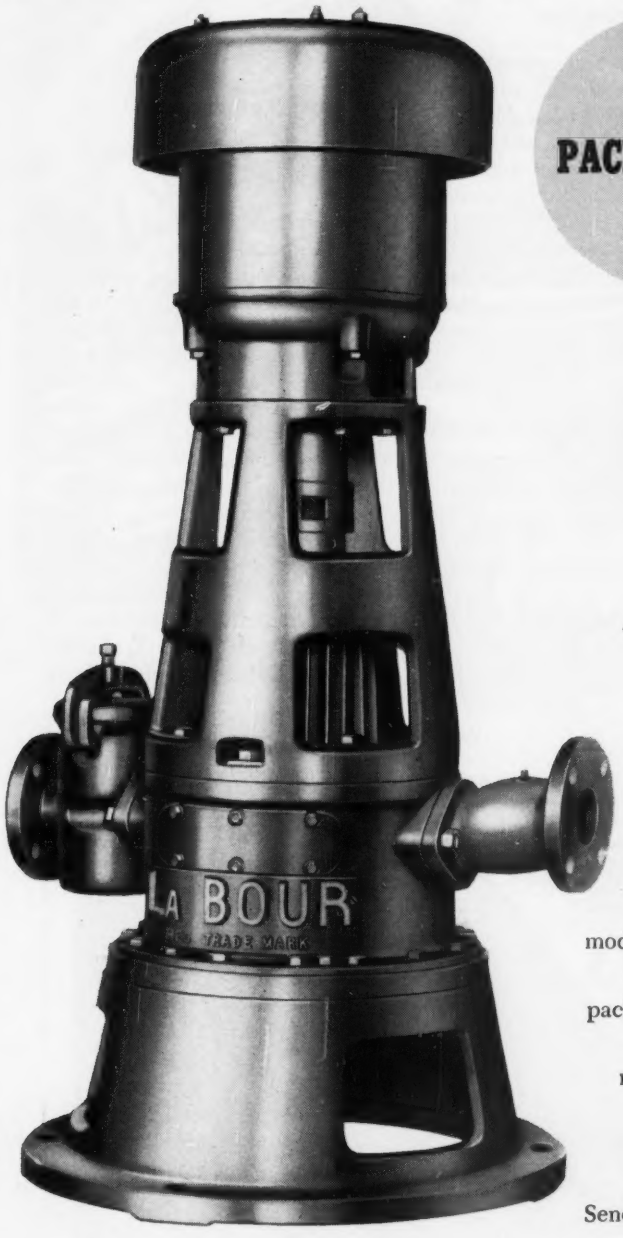
Liquid flow through the tower follows the slopes combining and redividing at each intersection. Gas passing through the mesh openings creates a finely divided spray.

▶ **Performance**–Uniquely, the louvered orientation of the expanded mesh prevents any leakage of the liquid before it reaches the bottom of the cell. This is the feature that maintains effective contacting action down to 50% of design loading, making Spraypak as flexible as many tray designs.

Flooding characteristics of Spraypak are quite different from those of conventional packings or plate constructions. It can operate right up to the actual point of flooding, and a column can operate practically within a few percent of that point. Ordinary packed or plate columns are designed more frequently for operation at 80% or less of floodpoint.

If the distillation is one which requires the best H.E.T.P. performance, the column should be operated within 5% or so of the

for Flooded Suction or Suction Lift



It's PACKINGLESS

It's SELF PRIMING

It's CENTRIFUGAL

It's LABOUR

The new Type CG LaBour is an improved model, operating under positive or negative suction lift conditions as required. It has no packing or close fitting parts in contact with the liquid.

The open end of the dynamic seal need not be exposed to atmosphere, so escape of volatile or toxic gases may be prevented.

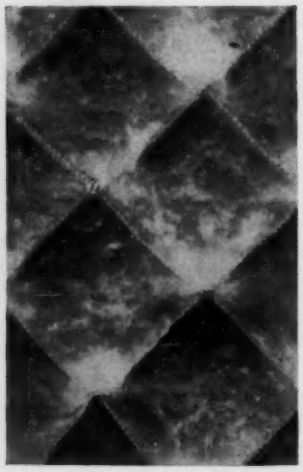
The seal can be flushed during normal operation if desired.

Send for your copy of Bulletin G-1, which gives complete details.

ORIGINAL MANUFACTURERS OF THE SELF-PRIMING CENTRIFUGAL PUMP

LABOUR

THE LABOUR COMPANY, INC. ★ Elkhart, Indiana, U.S.A.



END view of packing in operation shows intimate contact.

floodpoint. On batch columns this is done automatically through instrumentation. On continuous columns it is only necessary that the reboiler and condenser be large enough to allow smooth operation in the floodpoint range.

In cases where the column is to operate at less than maximum throughput, the loss in theoretical plates can be compensated generally by a slight increase in reflux ratio.

▶ **Even Flow**—Spraypak has the ability to distribute feed evenly across the tower. Even if a side inlet is used it will distribute evenly within a height less than the tower diameter.

Where necessary to remove all or part of the liquid draining from a given section of packing the tower can be provided with a collector or trapout plate.

▶ **Fitting the Job**—From a mechanical standpoint Spraypak is very adaptable to most any situation. It can be used in pilot plant columns down to 12-in. I. D. or in the largest commercial columns. It can be constructed to be self-supporting up to heights of 30 ft. or it can be installed in tray support rings spaced as closely as 18 in.—**Fractionating Towers, Inc., 5711 Boulevard East, West New York, N. J.** 234A

Filter Felt

Retains fine solids yet has high filtration rate.

A new chemical-resistant synthetic filter felt is made of tightly compacted resin-bonded fibers of Dynel. Principal uses will be for pressure filters and centrifuges.

Dynel felts have greater chemical resistance than previously available wool felts, do not shrink and because they keep their shape they are easier to fit in the presses. Maximum temperature is 170 F. Bursting wet strength is from 200-350 psi. which is more than is required for filtering applications.

Dynel felt is virtually unaffected by most concentrated mineral acids and bases, and is very highly resistant to a variety of organic acids, bases and salts. It is easy to clean, retains fine solids yet has a relatively high porosity.

One basic advantage is that the bonding resin is the same basic material as the Dynel fiber.—**Filtration Fabrics Div., Filtration Engineers, Inc., 155 Oraton St., Newark 4, N. J.** 236A

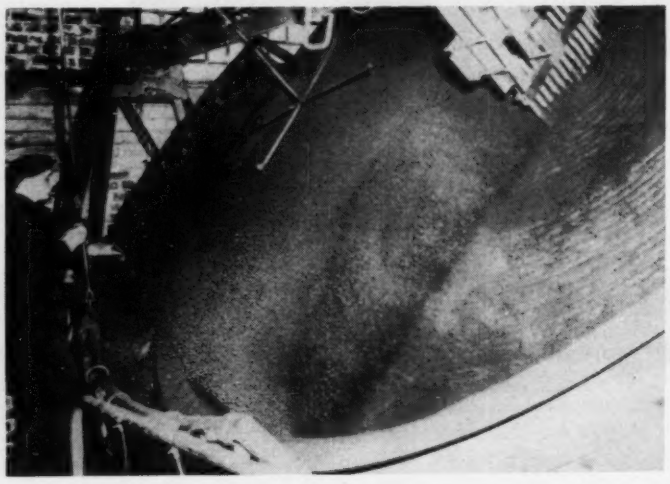
Sulfur Burner

Operates cleanly, has long service life.

A new type of compact sulfur burner developed by Kimberly-Clark Corp. now is being offered to the pulp and chemical process industries. The Chemipulp-KC jet-type sulfur burner is unusually compact, requiring only a fraction of the space taken up by rotary burners and combustion chambers.

Molten sulfur is sprayed into the burner as a fine mist. Secondary air is introduced in several stages. Operation is clean and service life long.

Burner operates efficiently at all SO_2 gas concentrations between 12 and 18½%. At 2,100 F. burner will burn dark sulfur efficiently as



Spinning Disk Pelletizes Iron Ore

First commercial disk in North America for pelletizing iron ore has been delivered to International Nickel Co.'s $16-million plant near Copper Cliff, Ont. It is similar to this 16-ft. Lurgi pelletizing disk shown operating in Europe. Inco's process produces iron ore pellets without using binders, plasticizers or solid fuels.—Dravo Corp., 1203 Dravo Bldg., Pittsburgh 22, Pa. 236B

It is a common practice to use standard "Klingerit" packing for many kinds of acids, but it is not suitable for nitric acid and a few other concentrated acids. "Klinger-Acidit" is therefore produced as a compressed asbestos sheet packing designed to resist hot nitric acid, hydrochloric acid, sulphuric acid, organic acids, etc. It is supplied in two qualities, hard and soft, and can be safely used for steam and pressures of up to 250 p.s.i. and is not damaged by oils, gasoline and other solvents, although it is not primarily intended for such uses.

Acid-resisting valve rings for Klinger piston valves and packing sleeves for Klinger sleeve-packed cocks are also manufactured from "Klinger-Acidit" material.

Write for the Klinger Master Catalog which describes the complete range of Klinger products.

RICHARD KLINGER LIMITED, KLINGERIT WORKS, SIDCUP, KENT, ENGLAND

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C/1/55/11

Newsworthy Equipment This Month

Equipment Cost Indexes, P. 246

New Processing Equipment
Expanded Metal Tower Packing 234A
Filter Felt 236A
Spinning Disk Pelletizer 236B
Sulfur Burner 236C
Crusher 238A
Polyethylene Scrubber 238B
Bubble Cap 238C
Pilot Plant Tools 238D

New Packaging & Handling Equipment
Floating Vapor Seal 240A
Compartmented Storage Tanks 240B
Skip Hoist 242A
Tractor Shovel 242B
Plastic Liner 242C
Vibrating Conveyor 242D
Bag Closer 242E
Carbon Black Container 242F

New Safety Equipment
Protective Suit 244A
Fire Hose 244B
Industrial Glove 244C
Extinguishing System 244D
Prevention Signs 244E

New Fluids Handling Equipment
Acid Pressure Valve 246A
Tank-Car Coupling 246B
Air-Cooled Compressor 246C
PVC Fittings 246D

New Heating & Cooling Equipment
Finned Tube 248A
Glass Heat Exchanger 248B
Pulsating Damper 248C
Cascade Cooler 248D

New Instruments & Controls
Pressure Pilot 250A
Pressure System 250B
Pressure Regulator 250C
Fire Detector 250D

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well as light sulfur at loads of 25 to 150% of rated capacity. Burner comes up to temperature quickly, thus minimizing production of SO_3. Shutdown is instantaneous.

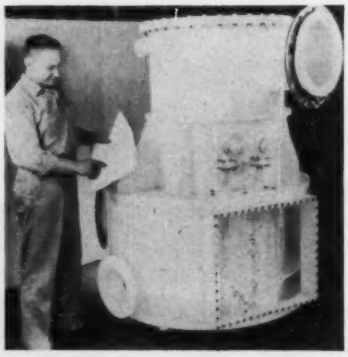
Available capacities are 1, 2½, 5, 12, 15 and 25 tons per day—**Chemipulp Process Inc., Watertown, N. Y.** 236C

Crusher

Breaks up lumps of caked materials.

Caked-up chunks or lumps of material up to 16-in. size are reduced to desired size by the Supreme 502P Crusher. Materials handled include urea cake, phenolic pellets, styrene pellets, ammonium nitrate, sugar, dye cake, hard candy, flour, cocoa cake, DDT and a great number of other lumped materials.

Depending upon the material the delumping rate is from 5 to 15 tons per hr. Feed is automatic. Dry and friable materials reduce to their original state. Wax-like, compressible or wet materials are delumped down to ¼ in. in the standard model and finer in modified standard machines.—**Franklin P. Miller & Son, Inc., East Orange 1, N. J.** 238A



Polyethylene Scrubber

Handles hydrofluoric acid and fluorides.

Here is an example of sizeable process equipment that is being fabricated from polyethylene. This is the largest scrubber ever made from polyethylene and will be used in contact with hydrofluoric acid and fluorides. Measuring 4 ft. in dia. and 5 ft. high, scrubber will handle 2,500 cfm. at 1½ psi.

Polyethylene processing units are proving virtually maintenance-free, it is claimed. Impact strength is excellent, as is chemical resistance at temperatures up to 170 F.

In fabrications similar to conventional steel equipment the polyethylene ones average only one third the weight. Welding is done by the hot gas process and there is no preferential chemical attack at the welds.—**American Agile Corp., 5461 Dunham Rd., Maple Hgts., Ohio.** 238B

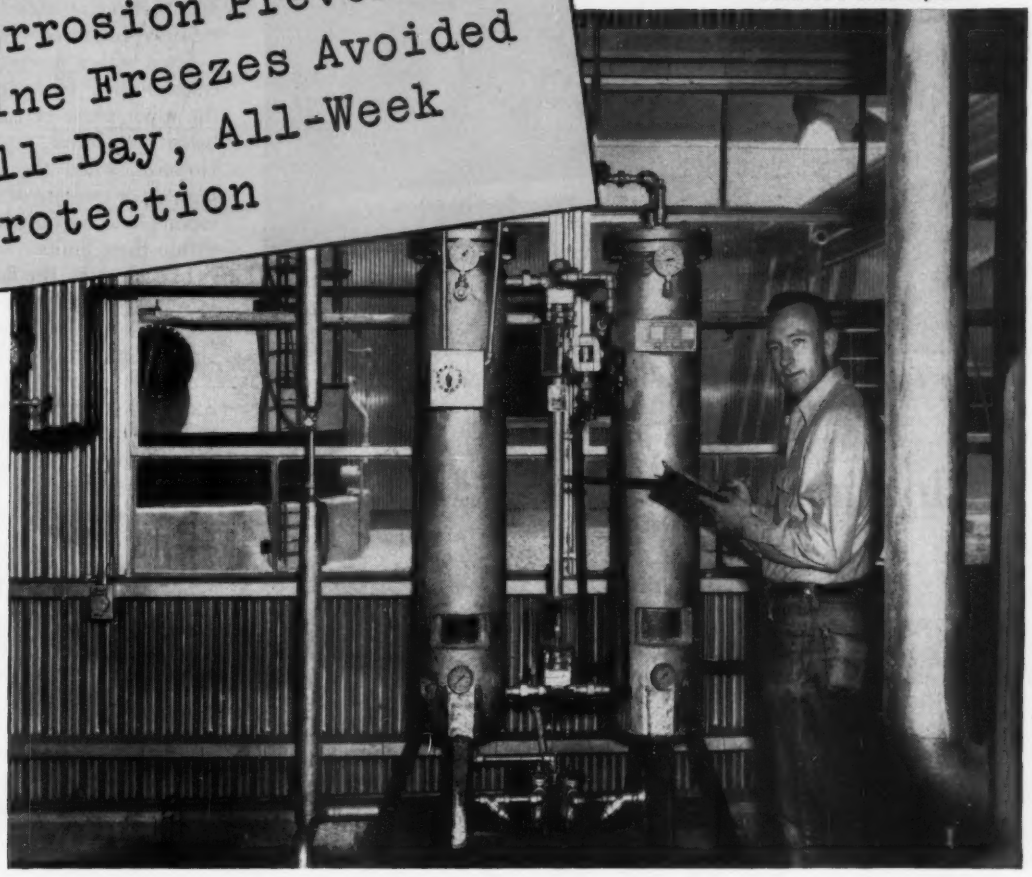
Bubble cap and riser assemblies are being offered cast in precision form of glass reinforced furfural-ketone resin with carbon loading. Withstand rough treatment and temperature to 350 F. Resist all solvents, alkalis and most acids. —**Carl Buck & Associates, Essex Fells, N. J.** 238C

Pilot plant tools now available are a small all-stainless steel mill and small scale dissolver. Designed especially for product development, laboratory control work and standardization of volume production formulas.—**Morehouse Cowles, Inc., 1150 San Fernando Rd., Los Angeles, Calif.** 238D

Case No. 108

Seaboard Oil Company Reports:

- Corrosion Prevented
- Line Freezes Avoided
- All-Day, All-Week Protection



Jerry Rea, plant worker, checks on the trouble-free operation of twin towers comprising Kemp Model 50-S Oriad Dryer.

Sulphur Producer Gets Automatic Drying of Compressed Air with Kemp

During their processing of sulphur and sweetening of natural gas, the Powell, Wyoming, plant of Seaboard Oil Company of Delaware needs large quantities of dried, compressed air to operate complex control instruments.

When their Silvertip Field plant was opened, the operators turned to Kemp to provide this dried air, installing a Model 50-S Kemp Dryer. The machine operates on a manual switching and automatic timing device. Imbedded steam coils reactivate the towers . . . permitting 25 cfm capacity at an exit pressure of 50 psi. The installation is operating 24 hours a day on a seven-day week — preventing corrosion and avoiding costly delays caused by line freezes in the plant.

If drying air or other gases is a problem in your operation, it will pay you to discuss your problems with a Kemp Engineer. He can recommend specific equipment to handle your specific problem . . . and give you the benefits of *every* Kemp installation—simplicity of operation and maintenance, low installation cost and minimum maintenance expense. A Kemp Engineer is ready to discuss your needs—without obligation.

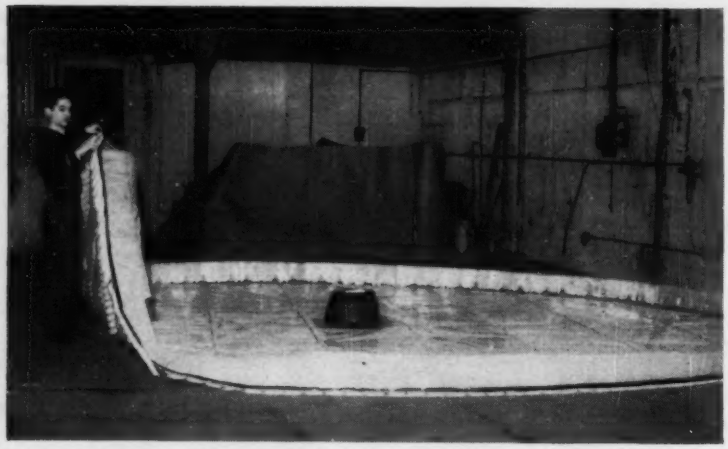
For detailed, technical information, ask for Bulletin No. D-29. Write to:

C. M. KEMP MFG. CO., 405 E. Oliver Street, Baltimore 2, Maryland

KEMP OF BALTIMORE

ADSORPTIVE DRYERS

ATMOSPHERE & INERT GAS GENERATORS
SINGEING EQUIPMENT • IMMERSION MELTING POTS
CARBURETORS • BURNERS • FIRE CHECKS



FOR STORAGE tanks, less product loss and profit shrinkage because . . .

Floating Screen Traps Vapor

Like a giant lily pad this plastic screen floats in storage tanks to minimize loss of volatile liquids. Explosion hazard in vapor space is reduced or eliminated.

Vapor loss from storage tanks containing crude and refined petroleum products and solvents can be reduced 80 to 90% by a new floating plastic screen.

Screen is a product of France but negotiations are underway for a U. S. firm to market the device. One large American refinery already has made arrangements to test.

Floating vapor seal can be furnished for any tank size. Currently, it is quoted at $1.25 per sq. ft. fob. France.

▶ **Carpet of Floats**—The screen is a continuous, flexible carpet of pure unplasticized polyvinyl chloride sheet. On the underside are a large number of small parallelepipedic floats of the same material arranged side by side. Made to measure, the screen covers all the free liquid surface in the tank leaving a gap of about 1 in. around the periphery.

To seal around the edge of the screen a flexible Z-shaped skirt is provided to contact the tank wall. It is sufficiently flexible to free itself should it get caught in rivets during rise or fall of the liquid.

Tank can be measured and sampled through openings fitted with vertical sleeves. The float of the level indicator also can be passed through these openings. A number of small holes permit condensation water to pass through into the bottom of the tank.

Cages of PVC tubes at each of the inlet and outlet openings prevent the screen from dropping below these points when the tank is empty. Thus, when liquid is pumped into the tank there is no possibility of flooding the screen from the top.

▶ **Installation**—Screen comes in sections measuring approximately 25 by 48 ft. Each section is rolled in cylindrical form approximately 2 ft. in dia. In this form sections can be introduced through a manhole into the emptied and thoroughly degassed tank.

Inside the tank a team of trained operators, provided by the manufacturer, assemble the sections into a finished screen by a simple patented procedure.

Prior to filling the tank with product it is filled with water to be certain that the screen rises and falls without interference.

▶ **Safety Improved**—When a tank is fitted with a floating screen, the concentration of hydrocarbons in the vapor phase is, in most cases, below the lower explosive limit. However, when the liquid has a high vapor pressure or temperature, vapor phase concentration may lie within these limits.

In such cases, the floating screen provides a high degree of protection. It insulates the liquid surface almost completely from the vapor phase. Any electrostatic charges present in the liquid will not be transmitted to discharge between liquid and tank walls or roof.

Also, a continuous wire netting in the screen is connected to ground to bleed off any accumulated electrostatic charges.

Still another precaution is to vent the tank through a special device that will keep hydrocarbon vapor at a low level. Only with the floating screen is this possible because the vertical skirt makes rate of evaporation practically independent of vapor phase concentration.—**Laroche Freres, 46 Rue Des Marais, Paris X, France.** **240A**

Compartmented Tanks

Store two or more products simultaneously.

Standard cone-roof storage tanks now can be modified to hold more than one product. Two or more liquid-tight compartments are installed within a single tank shell to keep products separate.

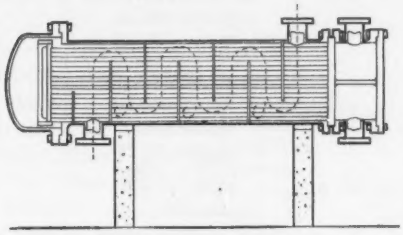
Tank is easy to erect in the field, yet absolutely safe for storing highly miscible products under one roof.

Compartmentation consists of an even number of vertical, semi-cylindrical plate units. By alternating these units, a looping or corrugated partition is created. Welded into a rigid partition, these corrugations are strengthened further by a series of horizontal supports.

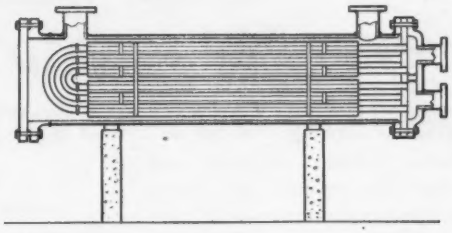
Access to the interior compart-

BROWN FINTUBE'S

BETTER DESIGN MEANS BETTER PERFORMANCE



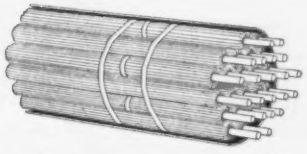
● Sectional View of Conventional Bare Tube Heat Exchanger Showing the Transverse Baffles that require the flow to make a series of 180° Bends, Resulting in Substantial Pressure Drop; Adding Unnecessarily to Pumping Costs; and producing Back Eddies, where Entrained Solids can Settle Out, Further Reducing the Heat Transfer Efficiency, and Increasing Cleaning and Maintenance Costs.



● Sectional View of Brown Fintube Bundle Exchanger. Fluid Flows through Hundreds of Long, Straight, Narrow Passages in Intimate Contact with the Heat Transfer Surface. The Only Pressure Drop Occurring Results from the Impingement of Flow Against the Heat Transfer Surface, and the Bends as the Fluid Enters and Leaves the Unit, Minimizing Pumping Costs, also Cleaning and Maintenance.

BROWN FINTUBE'S DESIGN ELIMINATES BAFFLES

Minimizing Pressure Drop



● View Showing the Banding of Alternate Fintubes to Prevent "Nesting", and Outer Bands that Produce a Tight, Compact Bundle of Long, Narrow, Straight Passages.

● The "bundle" in a Brown Fintube Exchanger consists of our integral "one-piece" fintubes connected with return bends; the other ends rolled into a tube sheet. A metal band strapped around each alternate fintube prevents "nesting", and the entire assembly is then banded tightly together.

This construction produces hundreds of long, narrow, straight passages, through which the fluid flows. Carefully controlled velocities develop a turbulent flow, keeping heat transfer coefficients in a desirable range. There are no baffles, as when bare tubes are used, with their 180° bends to cause pressure drop, and create back eddies where entrained solids can settle out. In Brown Fintube exchangers, pressure drop results *only*, from the impingement of the fluid against the heat transfer surface, and the bends entering and leaving the unit.

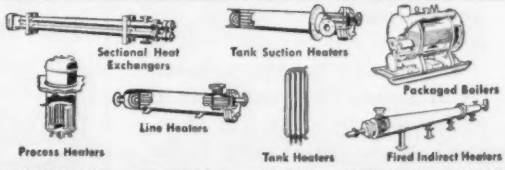
The "one-piece" fintubes, available in carbon steel, alloy or non-ferrous metals, have 6 or 8 times more surface than plain bare tubing. They transfer more heat per lineal foot than plain bare tubing, saving space and weight;— and at lower temperatures per square foot of surface, preventing damage to heat sensitive materials.

Write for Bulletin No. 521. It lists dimensions and capacities of standard sizes. Other sizes and designs to meet any requirement. Write for your copy of Bulletin No. 521 ***today!***

HEAT EXCHANGE SURFACE
BROWN FINTUBE
HEAT TRANSFER PRODUCTS

BROWN FINTUBE CO.

360 HURON ST., *Elyria, Ohio*



Engineering and Sales Representatives: **NEW YORK • BOSTON • PHILADELPHIA • PITTSBURGH • BUFFALO • CLEVELAND • CINCINNATI DETROIT • CHICAGO • ST. PAUL • ST. LOUIS • KANSAS CITY • MEMPHIS • BIRMINGHAM • NEW ORLEANS • SHREVEPORT • TULSA • HOUSTON • DALLAS DENVER • LOS ANGELES AND SAN FRANCISCO ● *Licensed Manufacturers:* BROWN FINTUBE (CANADA) LTD., ST. THOMAS, ONTARIO, CANADA BROWN FINTUBE (GREAT BRITAIN) LTD., BIRMINGHAM, ENGLAND • FRIEDRICH UHDE, GMBH, DORTMUND, GERMANY**

ments is easy; installation of gaging devices remains simple and standard. Each compartment can be filled and emptied individually through its own inlet and outlet.—**Graver Tank & Mfg. Co., Inc., East Chicago, Ind.** 240B

Portable Skip Hoist

Cuts manual labor and eliminates hazards to workers.

New portable skip-hoist and dumper lifts, up-ends and dumps any free-flowing material at rates up to 15 tons per hr. It can be adapted to handle bags, boxes, drums and barrels.

Safe operation is assured by such features as slack cable safety switch, automatic stops at top and bottom and a solenoid-operated brake. Unit is mounted on casters for easy portability. Also, it may be locked in position.

Skip-hoists are built in any one standard dumping height from 2 to 7 ft. Base is 36 by 46 in.—**Colson Equipment & Supply Co., 1317 Willow St., Los Angeles 13, Calif.** 242A

Tractor Shovel

Uses new concept to break out load at ground level.

Two entirely different four-wheel-drive tractor shovels provide 40 degrees of bucket "breakout" at ground level rather than at a three or four foot "carry" position. Model HU has a heaped capacity of 1 cu. yd.; model HH 1½ cu. yd.

To obtain maximum loads with minimum effort, breakout pads are used on the ground to exert a powerful prying out action. The opposing load forces are thereby transferred through the pads to the ground rather than through the axle, wheels and hydraulic system.

The fact that the load is broken out at ground level contributes to safety and speed of operation. Loads can be carried closer to the machine and at a lower level than usual for greater stability.

Machines come with choice of either gasoline or diesel power; have more horsepower and weight in relation to bucket capacity than competitive models, it is claimed.—**The Frank G. Hough Co., 754 Seventh St., Libertyville, Ill.** 242B

Plastic Liner

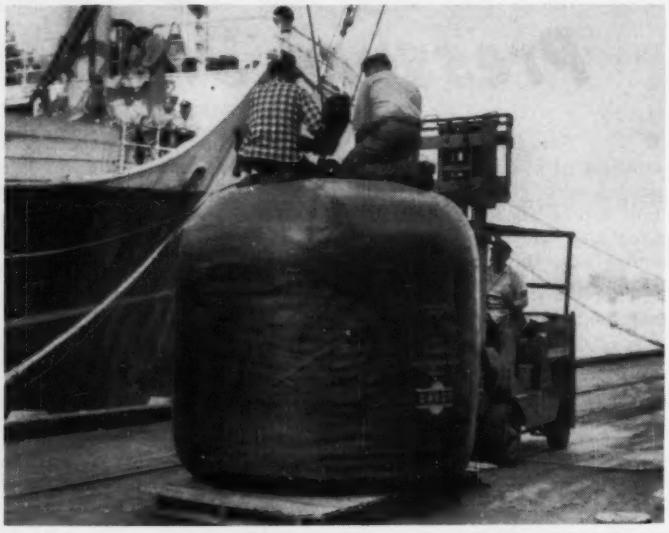
In heavy gage for steel containers.

Chemicals and other liquids can be transported at reduced cost in the new JaLiner plastic lined steel containers. Use of the Jaliner reduces the tare weights and shipping cubes for the transportation of chemicals and other products which are usually shipped in stainless steel, glass or molded plastic containers. Insurance rates are cut.

JaLiner is constructed of heavy-gage polyethylene tubing and sheet. It is custom tailored to fit the exact dimensions of the steel container. Stress is reduced, thereby, and durability increased. Installed during fabrication of the container it becomes an integral part of the container.—**Jones & Laughlin Steel Corp., Container Div., 3 Gateway Center, Pittsburgh 30, Pa.** 242C

Vibrating conveyor has minimum of moving parts, is oscillated by three eccentric weights held on individual shafts on the drive assembly. Each Oscilveyor consists of one drive unit and any number of standard trough units.—**Gifford-Wood Co., Hudson, N. Y.** 242D

Portable bag closer handles textile and paper bags closing them in an average of less than 6 sec. Weighing only 10½ lb. stitcher operates from any 110-v. a.c. line and can be held in one hand.—**Dave Fischbein Co., 38 Glenwood Ave., Minneapolis 3, Minn.** 242E



Carbon Black Container Tested on Sea Lanes

First trial shipment of carbon black in new type returnable rubber container is loaded aboard Holland-American vessel Almdyk at Port of Houston. With a gross weight of 9,180 lb., the 370 cu. ft. container was lifted by a eye at the top connected to internal lifting cables running through to the bottom. Container is built of synthetic rubber and fabric.—U. S. Rubber Co., Rockefeller Plaza, New York, N. Y. 242F

- Steering Collar Insulator
- Radiator Hose
- Heater Hose
- Body Insulators
- Heater Can Anti-Squeak Pad
- Steering Post Bracket Insulator
- Spark Plug Covers
- Steering Post Pads
- Radiator Drain Tube
- Silent Block Bushing
- Tail Pipe Insulator Support
- Wiper Hose
- Antenna Gaskets
- Division Channel Weatherstrip
- Window Channel Filler Seal
- Parking Light Lens Gaskets
- Bumper to Fender Spacer
- Fresh Air Adapter Grommets
- Battery Drain Tubes
- Gearshift Lever Arm Bushing
- Replacement Tubes
- Frame & Axle Bumpers
- Spring Shackle Bushings
- Fender & Engine Compartment Dust Shield
- Steering Wheel Spoke Ornament Cushion
- Instrument Panel Anti-Squeaks, Wiring Grommets
- Windshield Wiper Pivot Pad & Bracket Grommet
- Rear Window Weatherstrips
- Horn Ring Ornament Cushion
- Dash Liner & Cowl Trim Pads
- Door Check Arm Bumpers
- Stone Deflector Bumper
- Sound Deadener Insulation
- Tubeless Tires
- Wiring Clips
- Body Shims
- Headlight Lens Gaskets
- Radiator to Hood Seals
- Tail & Stop Lamp Lens Pads
- Radiator Seals
- Hood Lacing
- Fender Seals
- Hood Bumpers
- Bumper Grommet
- Glove Box Door Bumpers
- Gas Tank Filler Neck Grommet
- Sill Mats & Attaching Grommets
- Defroster Hose
- Door Bumpers

super-durable Enjay Butyl protects '55 cars in over 100 places

It's good news for car owners that the rubber parts that used to crack, chip, and practically disintegrate under tough road and weather conditions are being replaced with parts made from super-durable Enjay Butyl. In over 100 vital places, Enjay Butyl helps give many '55 models the performance and appearance that make them a pleasure to drive, an economical unit to maintain.

If you make a product in which rubber is used, or *could* be used, you owe it to efficient business practice to investigate the many advantages that Enjay Butyl has over other types of rubber. Its price is a definite advantage, too. Complete laboratory and technical facilities are at your service. For full information contact the Enjay Company today.

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the super-durable rubber with *outstanding* resistance to aging * abrasion * tear * chipping * cracking * ozone and corona * chemicals * gases * heat * cold * sunlight * moisture

35 SUCCESSFUL YEARS OF LEADERSHIP IN SERVING INDUSTRY

Protective Suit

Inflated to prevent hazardous materials from entering.

When an emergency calls for action to prevent dangerous chemicals from spreading damage to property and personnel, protective garments must be equal to the need. Often garment materials bar entrance of liquids yet corrosive gas works through.

The Emergency Suit overcomes both penetration of liquid and gas seepage. Air from an outside source inflates the suit and constantly maintains controlled, positive air pressure within the garment. No longer is it possible for gas to enter zippers or tiny openings.

Gra-Lite fabric used in the garment is claimed to be impervious to virtually all organic and most inorganic compounds. Also, it exhibits unusual resistance to abrasion.—**Standard Safety Equipment Co., 232 West Ontario St., Chicago 10, Ill.** 244A

Fire Hose

Withstands abuse of rough industrial usage.

A new all-Dacron, neoprene-impregnated fire hose, tabbed Fyr-Fyter Tuff-Weave, withstands oil, chemicals, mildew and rough use. Tube of hose is oil-resistant neoprene. The covering is fabricated of strands of 100% Dacron yarn which in turn is impregnated with a coat of neoprene.

Test pressure for this hose on delivery is 500 lb. per 50 ft. length. It is available in 1½ and 2 in. sizes. —**Fyr-Fyter Co., 221 Crane St., Dayton 1, Ohio.** 244B

Industrial Glove

Is comfortable even though made of rubber.

A recent innovation is a flock-lined neoprene industrial glove. The New Stanzoil NS-35 features a lining of thousands of tiny cotton particles bonded to the inside of the glove.

The flock-lined glove gives the wearer maximum comfort without decreasing finger dexterity. At the same time the glove has an effective molded non-slip grip on fingers and palm.—**Pioneer Rubber Co., Willard, Ohio.** 244C

Extinguishing System

Completely new pressure-operated carbon dioxide type.

In a significant new design development, a new highly flexible extinguishing system operates on a rate-of-temperature-rise principle. It employs carbon dioxide under pressure of 850 psi. both for its power and as its fire extinguishing agent.

If a fire occurs in a Class B or C hazard (flammable liquid or electrical equipment), the rapidly rising heat increases air pressure within one or more small heat actuators mounted throughout the hazard area. This increased pressure is transmitted through small diameter copper tubing to master pneumatic control heads mounted on two of the system's carbon dioxide storage cylinders.

This impulse triggers the control heads thus releasing the pressurized carbon dioxide in these two cylinders. Gas rushes from its containers and enters manifold piping to which other carbon dioxide cylinders are connected and opens the pressure-operated valves of these other cylinders releasing their gas.

Total charge then is routed through piping to the fire area where it discharges from Multijet nozzles.

System can be modified so that carbon dioxide passing through the piping will close vents, dampers, windows and shut off machinery, etc. Or alarms can be caused to sound in one or more locations.—**Walter Kidde & Co., Inc., Belleville 9, N. J.** 244D

Prevention Signs

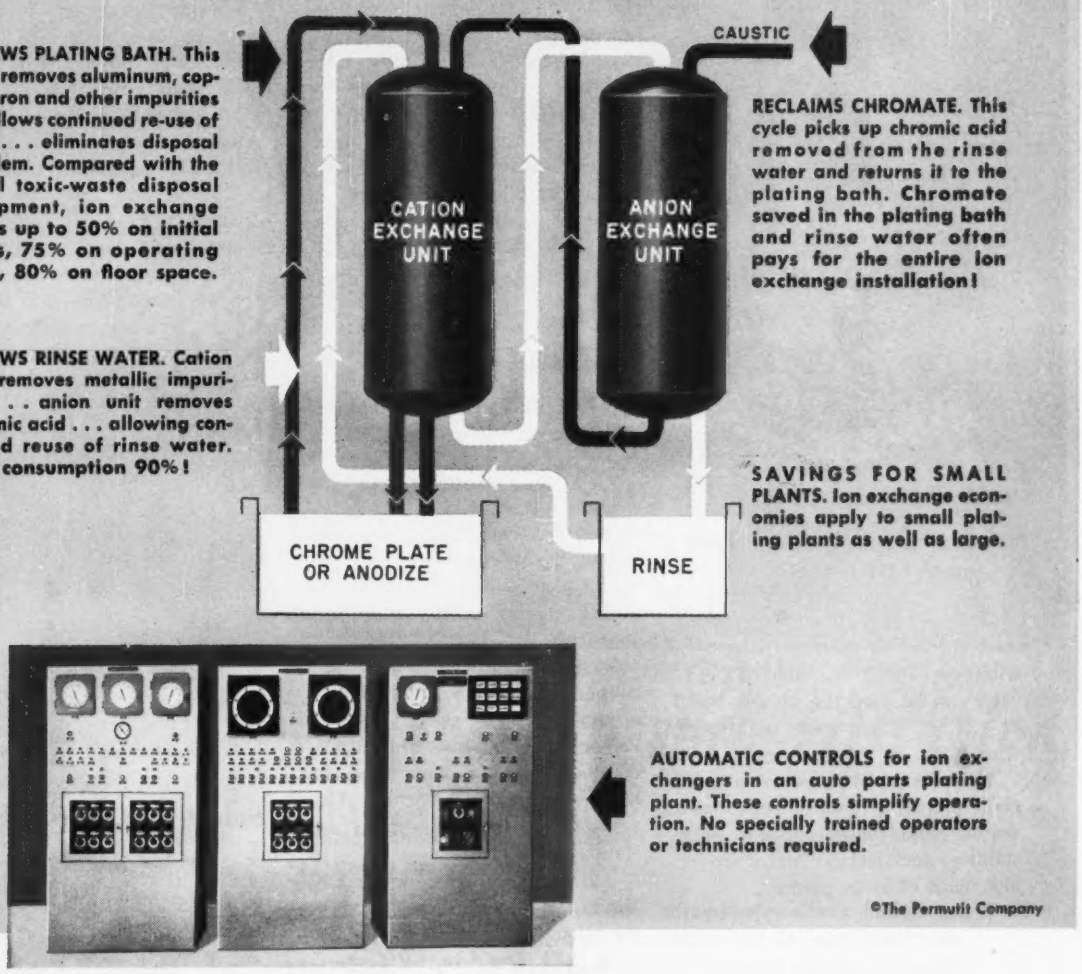
Now stocked in three self-sticking sizes.

Self-sticking accident prevention signs are now available in three standard sizes: 5 x 14 in., 3½ x 10 in., and 2¼ x 9 in. Signs include both basic purpose signs such as "Danger" and specific purpose signs such as "Caution, Wear Eye Protection."

Signs are in wordings and colors specified by American Standards Association Std. Z-35.1-1941 There are over 1,000 different stock specific purpose signs to let you make up many thousands of different accident prevention signs at low cost. They can be used alone or combined with basic purpose signs as shown in the combination picture above.—**W. H. Brady Co., 772 West Glendale Ave., Milwaukee 12, Wis.** 244E

PROCESSES: Ion exchange "swaps" chemicals in solution at high speed . . . purifies, recovers, concentrates, separates. An example:

How Ion Exchange Cuts Plating Costs


RENEWS PLATING BATH. This cycle removes aluminum, copper, iron and other impurities . . . allows continued re-use of bath . . . eliminates disposal problem. Compared with the usual toxic-waste disposal equipment, ion exchange saves up to 50% on initial costs, 75% on operating costs, 80% on floor space.
CAUSTIC
CATION EXCHANGE UNIT
ANION EXCHANGE UNIT
RECLAIMS CHROMATE. This cycle picks up chromic acid removed from the rinse water and returns it to the plating bath. Chromate saved in the plating bath and rinse water often pays for the entire ion exchange installation!
RENEWS RINSE WATER. Cation unit removes metallic impurities . . . anion unit removes chromic acid . . . allowing continued reuse of rinse water. Cuts consumption 90%!
SAVINGS FOR SMALL PLANTS. Ion exchange economies apply to small plating plants as well as large.
CHROME PLATE OR ANODIZE
RINSE
AUTOMATIC CONTROLS for ion exchangers in an auto parts plating plant. These controls simplify operation. No specially trained operators or technicians required.
©The Permutit Company

Ion Exchange Cuts Process Costs

A fast-growing unit process, ion exchange is already a multi-million-a-year business. Here are some of the jobs it's doing now:

• **Water Conditioning** is biggest ion exchange use . . . removing scale-forming hardness for homes, steam boilers . . . softening cooling water so it can be used over and over . . . purifying process water for TV tubes, synthetic fibers . . . reclaiming waste water (e. g. chromate plating rinses).

• **Process applications:** Removing impurities from formaldehyde, glycerin, alcohol, plating baths and other chemicals, also wines, sugar solutions; recovering copper and zinc from rayon plant wastes; concentrating metals in dilute solutions such as plating rinses, mine waters; removing iron from phosphoric acid pickling solutions; producing colloidal silica used in textiles, waxes, foundry molds; making antibiotics, e.g. streptomycin, and other medicinals.

• **Largest manufacturer** of ion exchange equipment, The Permutit Company (N. Y.), got a head start in ion exchange with the natural zeolites first used in water conditioning . . . now manufactures highly efficient synthetic resin ion exchangers of all types. Permutit is the only U. S. producer of both resins and equipment. Making both allows proper "mating" of the two . . . enables Permutit to take responsibility for performance of the entire installation.

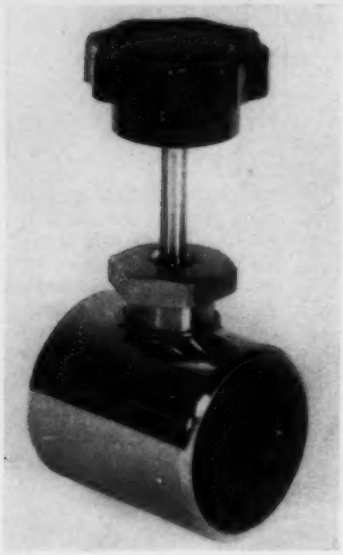
If you have a problem involving the recovery, concentration or separation of chemicals in solution, a Permutit ion exchange process can probably help you. Address: The Permutit Company, Dept. CE-8, 330 West 42nd St., New York 36, N. Y.

PERMUTIT®

rhymes with "compute it"

ION EXCHANGE

for Water Conditioning • Chemical Processing



Acid Pressure Valve

Will control corrosive liquid up to 1,000 psi.

Designed primarily as a control valve for highly corrosive acid distribution lines, the new BX115 valve can be used also on any type of corrosive liquid under high pressure.

Valve is constructed of a specially prepared, homogeneous, nonporous Saran plastic enclosed in a stainless-steel jacket. Valve tip is also made of Saran plastic.

Perfect sealing of the valve stem is assured through use of a synthetic rubber O-ring. For special applications Teflon or other specified materials can be furnished. Special safety features prevent valve stem blowout and guard the valve seat against damage from excessive tightening.

Valve is available in two standard sizes with the ports tapped for either ⅛ or ¼ in. standard metal or plastic pipe.—**Exline Engineering Co., 1636 East 6th St., Tulsa, Okla.** 246A

Equipment Cost Indexes

	Dec. 1954	March 1955
Industry		
Avg. of all	184.2	186.2
Process Industries		
Cement mfg.	177.1	178.4
Chemical	185.7	187.1
Clay products	171.9	173.2
Glass mfg.	175.5	176.8
Paint mfg.	178.8	180.1
Paper mfg.	179.1	180.4
Petroleum ind.	182.3	183.7
Rubber ind.	184.7	186.1
Process ind. avg.	182.8	184.2
Related Industries		
Elec. power equip.	187.5	188.9
Mining, milling	186.6	188.0
Refrigerating	204.1	206.8
Steam power	175.0	176.3

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago, for 47 different industries. See *Chem. Eng.*, Nov. 1947, pp. 124-6 for method of obtaining index numbers; March 1955, pp. 178-9 for annual averages since 1913.

Tank-Car Coupling

Permits cars to be unloaded faster and more efficiently.

Tank cars containing petroleum or liquid chemicals can be unloaded with greater ease using a new nonferrous elbow coupling. It's 66% lighter than the malleable iron or bronze coupling now used by most petroleum and chemical firms.

Standard 4-in. malleable iron coupling weighs 15 lb.; new nonferrous coupling weighs 4¾ lb. Lighter weight allows one man to do the job, eliminates need for heavy, unwieldy wrenches. One year of field testing indicates substantial labor savings.

All couplings have union tank thread 5¼ in. dia., four threads to the inch. They can be furnished with 2, 2½, 3 or 4 in. I.P.T. shank. Couplings can either be screwed into standard pipe coupling or soldered directly to flexible metal hose.—**The Atlantic Metal Hose Co., Inc., 308 Dyckman St., New York 34, N. Y.** 246B

Air-Cooled Compressor

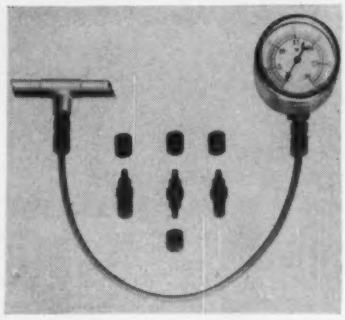
Incorporates in 20 hp. size features of big units.

Featuring a big-compressor channel-valve design the new model 20T air-cooled compressor offers operating efficiency, economy and dependability. Other advantages claimed for this 20 hp. unit are greater intercooling capacity, new cyclone flywheel fan, three cylinder construction and cylinder sizes engineered for the most air at desired pressure.

Unique design of the channel valve prolongs valve life. A controlled air cushion between each valve channel and its bowed-leaf spring prevents valve impact. Larger valve areas mean higher efficiency and lower discharge temperatures.

Compressor can be direct-coupled to a 1,200 rpm. motor. Horsepower saved permits compression of an additional 6% air.

Single-stage units rated at 40, 60 and 80 psi.; two-stage units at 100, 200 and 250 psi.—**Ingersoll-Rand, 11 Broadway, New York 4, N. Y.** 246C

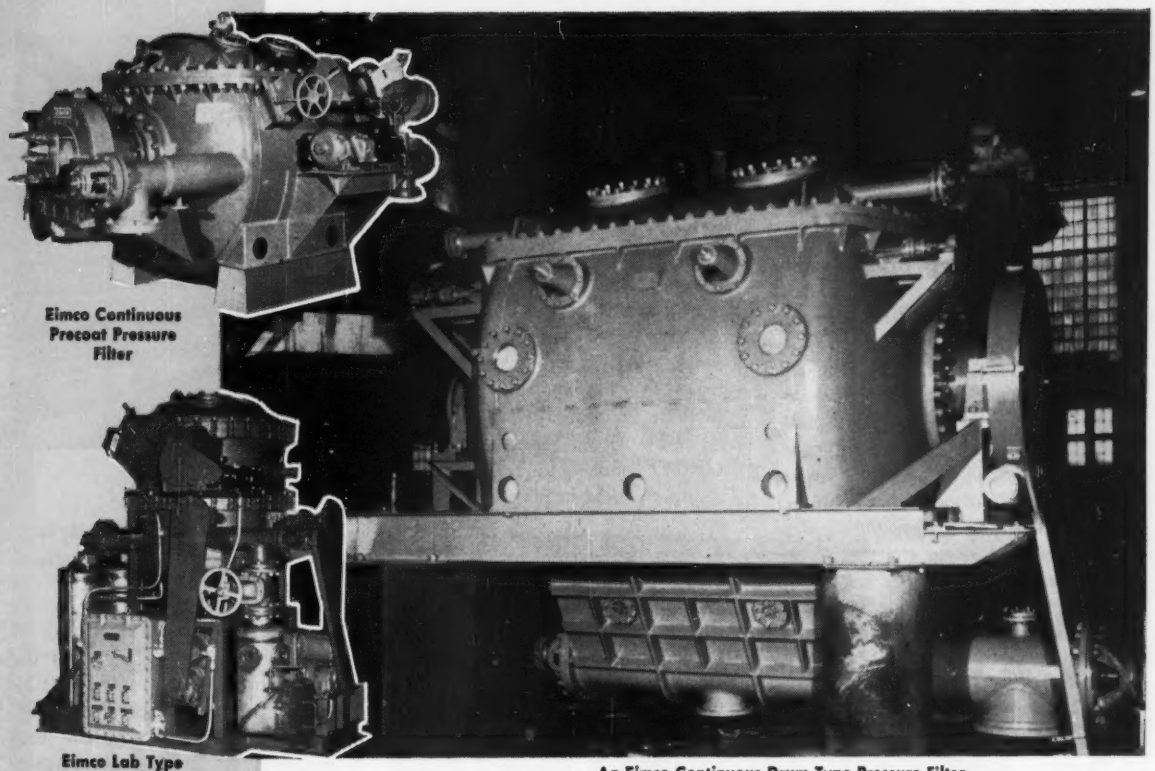


Small PVC Fittings

For use with flexible tubing.

New PVC fittings and adaptors are suitable for tubing-to-tubing and tubing-to-pipe connections in ¼ to ⅜ in. range. They may be used for many types of flexible liquid- and air-tight instrument tubing connections; in air or fluid actuated devices; for connecting direct reading pressure gages to tubing systems and for industrial transmission of fluids and gases.

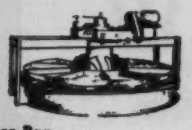
The adapters have a tapered nozzle which fits into the tubing. A screw cap slips over the tubing, engages threads in the adapter and draws tubing and adapter together into a liquid-tight, air-tight connection. The opposite end of the adaptor is threaded with standard IPS threads for ⅛ or ¼ in pipe. The unions have tapered nozzle sections and screw caps at both ends.—**S. & C. Mfg. Co., 6245 Wiede Rd., Cincinnati 13, Ohio.** 246D



Eimco Continuous Precoat Pressure Filter

Eimco Lab Type Continuous Pressure Precoat Drum

An Eimco Continuous Drum Type Pressure Filter



Eimco Pan Filter

Eimco Pressure Roll Filter

Eimco Bi-Carb Filter

Eimco Agidisc Filter

Continuous Pressure Filtration

offers a means of solving difficult process problems which have heretofore been unanswerable.

These filters are offered only after the problem has been studied by Eimco's Research and Development Division and each filter station is then designed and constructed to handle each user's problem on an assured result basis.

Pilot plant operations are conducted on proportional sized filtration equipment of all types in Eimco's Research and Development Center or in the customer's own plant.

Successful production size installations based on findings made by Eimco's Research and Development Division prove the value of starting new flow sheets through this thorough and exhaustive method of testing to obtain all the facts.

Let us tell you more about Research in liquids-solids separation through filtration.

THE EIMCO CORPORATION

Salt Lake City, Utah—U.S.A. • Export Offices: Eimco Bldg., 52 South St., New York City

New York, N. Y. Chicago, Ill. San Francisco, Calif. El Paso, Tex. Birmingham, Ala. Duluth, Minn. Kellogg, Ida. Baltimore, Md. Pittsburgh, Pa. Seattle, Wash. Pasadena, Calif. Houston, Texas Vancouver, B. C. London, England Gateshead, England Paris, France Milan, Italy Johannesburg, South Africa

B-124

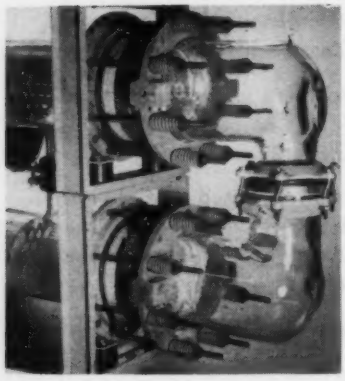
Finned Tube

Gives high conductivity without oxidation at 1,700 F tip temperature.

Heat produced during catalytic reaction or regeneration of the catalyst now can be recovered efficiently from the high temperature gas. A new finned tube construction, known as the high temperature K-Fin, permits more compact furnaces to be built at a lower cost than was possible previously.

K-Fin consists of a dual-metal helical fin sealed to the tube by a special brazing alloy. The fin has a copper interior that conducts heat rapidly and an austenitic stainless steel cladding that resists oxidation. Fin is embedded in the tube by a patented process and sealed with a nickel-chrome brazing alloy.

These new fins can be used in convection heaters with inlet gas temperatures as high as 2,600 F., heating liquids within the tubes to temperatures up to 1,500 F. Fin tip temperature is maintained at a temperature closely approaching that of the tube fluids; it is well within permissible operating limits for stainless steel.—**The Griscom-Russell Co., Massillon, Ohio.** 248A



Glass Heat Exchanger

Gives top operating flexibility because corrosion resistance is outstanding.

Backed by one year of successful field tests production of the Pyrex brand shell and tube heat exchanger has gotten underway. The completely new unit was developed for processing industries where chemical resistance and product purity are primary considerations. The 50 sq. ft. exchanger has proved to be highly efficient, versatile and economical to install, operate and maintain.

Main body of the unit is standard 6-in. Pyrex brand glass pipe. Twenty-six thin-wall Pyrex brand tubes running the length of the shell are supported every six inches by baffle plates. The header assembly of Teflon and high alumina ceramic is held in place by a Monel retainer ring and steel flanges and springs coated with epoxy resin.

The light-wall tubes have a conductivity coefficient, h, of 260 Btu./hr./ft.^{2}/deg. F. Over-all value, U, has been measured up to 195 Btu./hr./ft.^{2}/deg. F. in water-to-water tests. Operating temperatures up to 375 F are possible on the shell side and 200 F on the tube side. Operating pressures can be as high as 20 psi.—**Corning Glass Works, Corning, New York.** 248B

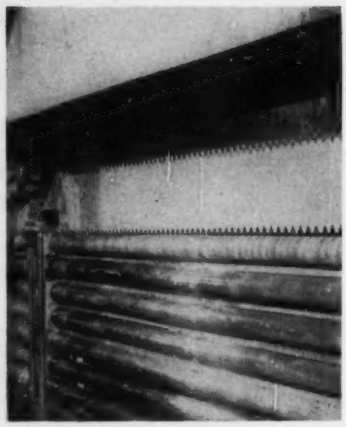
Pulsating Damper

For clinker cooler steadies kiln operation, saves fuel.

Through use of a new pulsating damper, kiln operators get more rapid clinker cooling, better and steadier combustion, improved fuel economy, elimination of temperature differential in the cooler grate and prolonged grate life.

Damper is installed in the air duct between the cooler fan and the body of the cooler to create a pulsing flow of air to the cooler. This levels off or evens out the flow of air from the cooler into the kiln. Result: reduced heat loss and fuel costs, combustion stabilized in the kiln.

Damper is driven by a small d.c. motor and gear reducer mounted outside the duct work. Damper vane is welded and is fitted on a shaft which revolves in antifriction bearings.—**Allis-Chalmers Mfg. Co., Milwaukee 1, Wis.** 248C



Cascade Cooler

Cools corrosives efficiently from 700 F in the open atmosphere.

Corrosives can be cooled at temperatures up to 700 F in the open atmosphere using a new standard design cascade cooler. This practical and efficient unit combines Impervite resin-impregnated graphite and Graph-I-Tite carbon-impregnated graphite in one cooler.

Graph-I-Tite is used in the inlet tubing where the corrosive enters at high temperature. The remaining tubing in the cooler, where temperature is below 340 F, is made of Impervite. Immune to most corrosives, cooler has high thermal conductivity and low expansion.

Tubing in this cascade cooler is extruded by a special method which almost completely eliminates laminations, the manufacturer claims. This improved extrusion method results in more uniform heat transfer and eliminates the normal tendency of graphite to spall at its high temperature limit.—**Falls Industries, Inc., 31915 Aurora Rd., Solon, Ohio.** 248D

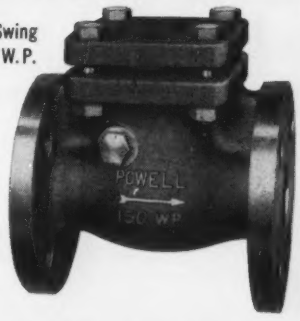
For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.

POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

. . . THE COMPLETE QUALITY LINE . . . POWELL VALVES . . . THE COMPLETE QUALITY LINE . . .

FIG. 2342—Flanged End Bolted Cap Swing Check Valve for 150 Pounds W.P.



POWELL CORROSION RESISTANT VALVES

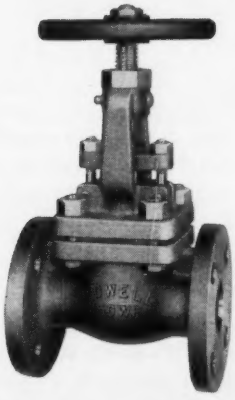
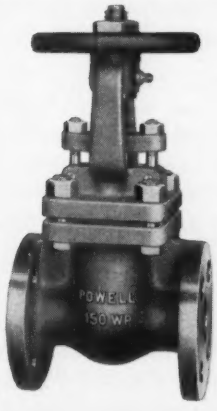


FIG. 2475—Stainless Steel O.S.& Y. Globe Valve for 150 Pounds W.P.

FIG. 2495—Double Disc Flanged End O.S.& Y. Gate Valve for 150 Pounds W.P.



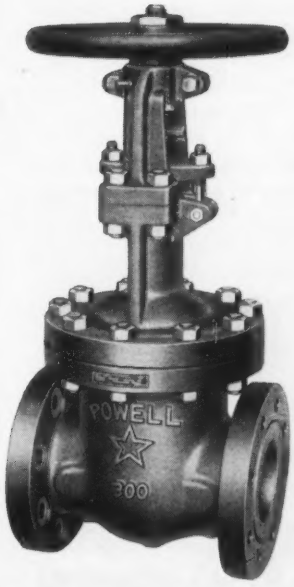


FIG. 3003SS—High Pressure Service Alloy Steel Gate Valve for 300 Pounds W.S.P.

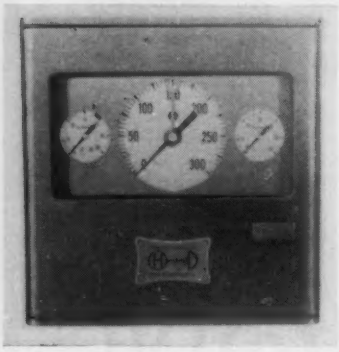
POWELL VALVES . . . THE COMPLETE QUALITY LINE . . . POWELL VALVES

Powell can supply exactly the corrosion resistant valves you need . . . in a WIDE VARIETY of metal and alloys and all designs. You can be certain that every Powell Valve will give you dependable flow control.

Shown above are a few Powell Corrosion Resistant Valves. Investigate these . . . and the *complete* Powell line of quality valves that have a proven record of long, dependable service.

If no distributor is near you, we'll be pleased to tell you about our complete line, and help solve any flow control problem you may have. Write . . .

The Wm. Powell Company, Cincinnati 22, Ohio . . . . . 109th year



Pressure Pilot

Is compact, versatile and simple to operate.

Featuring self-contained design, the new Model 110 pressure pilot indicates process pressure and provides direct setting of the control point on the same calibrated gage dial. This inexpensive instrument incorporates feedback proportional control or differential gap control with snap action over a 2-100% band.

All-metal power relay makes possible low nozzle pressures for linear response. Output pressure varies up to 30 psi. for positive valve action. The sapphire nozzle feed orifice is equipped with a push-button cleaner.

Knobs or friction screws serve to switch to a different control action, reverse output action or set the control point. Bourdon elements range from 0-15 to 0-10,000 psi. **–Hammel-Dahl Co., 175 Post Rd., Providence 5, R. I. 250A**

Pressure System

Measures up to 200 pressures simultaneously.

Now up to 200 pressures can be measured at a given instant and read out as digital values within two minutes. Initial instrumentation costs and future maintenance costs are minimized by using a single sensing device for all measurements, and a yes-no electrical system requiring no critical voltage adjustments.

System consists of a number of pressure comparators, each of which receives on the signal side of its diaphragm one of the pressures to be sensed. The other side of each comparator is connected to a common manifold into which a pressure "sweep" is introduced.

All pressures are sensed simultaneously by having them sealed within the comparators by solenoid valves at the beginning of the sensing cycle. As the sweep pressure in the common manifold becomes equal to the various pressures in the comparators electrical contacts are actuated to store the individual pressures in the electrical memory system.

Upon completion of the sweep cycle, the readout cycle begins automatically. Selector switches sequentially connect the memory cells with the digital readout device –an IBM typewriter, a Flexowriter, a tape punch, etc. Thus readout is available on log sheets, punched tape, or for feeding directly into a digital computer.–**Fischer & Porter Co., 356 Jacksonville Rd., Hatboro, Pa. 250B**

Pressure Regulator

Controls over wide range of temperature and pressure.

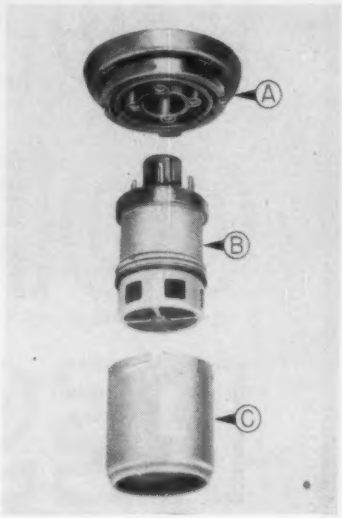
A new type of gas-pressure regulator provides accurate, dependable control over a wide range of temperature and pressure.

Pneumatic balancing in this single-stage unit maintains regulated pressure over a wide range of inlet pressures. Efficiency equals that found previously only in multiple-stage units. Hazardous gases can be handled with greater safety because external bleed has been eliminated.

Simplified, straight-through design permits more compact installation. At the same time unit makes more efficient use of stored gas volume.–**Special Products Div., Reaction Motors, Inc., Rockaway, N. J. 250C**

For More Information . . .

about any item in this department, circle its code number on the Reader Service Postcard inside the back cover.



Fire Detector

Utilizes radioactivity to detect fire at incipient stage.

Choke off fire before it has a chance to come roaring into the open. That's the function of the new C-O-Two Pre-Detector System.

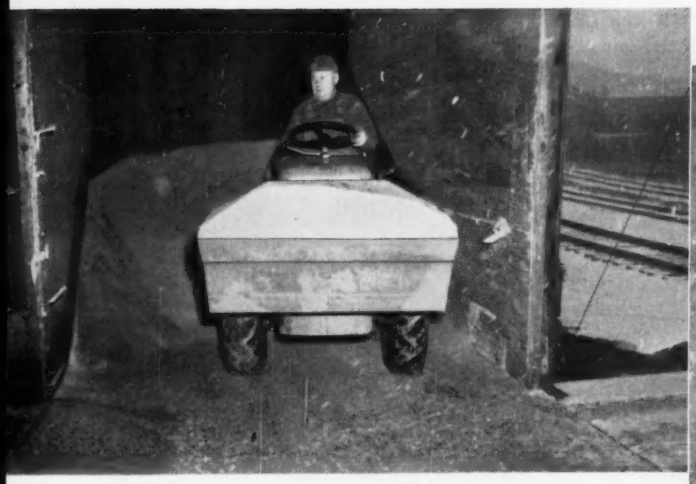
First manifestation of fire in ordinary combustibles is the presence of invisible combustible gas, then smoke, followed by flame and heat. The C-O-Two Pre-Detector senses combustible gas and smoke to actuate alarm while fire is still in the incipient stage.

Heart of the system is an overhead detection device connected electrically to a fire-indicating cabinet. This device contains two ionization chambers, activated by alpha radiation, and a highly-sensitive gas discharge tube.

The ionization chambers are adjusted to a balanced electrical state with one open to the atmosphere and the other virtually sealed. Entrance of combusion gases into the open chamber immediately unbalances the electrical circuit allowing the gas-discharge tube to conduct electricity actuating the alarm.–**C-O-Two Fire Equipment Co., Newark 1, N. J. 250D**

Half-Yard Loader Scoots Around in Boxcar

Compact Tractomotive TL-6 Tracto-Loader is High Producer in Confined Areas



Feeds Conveyor From Inside Boxcar

TL-6 Tracto-Loader moves bulk material from a boxcar to a conveyor set up just outside car door. This 33.7 hp loader has a full half-yard bucket, yet it can scoot around in this confined area, make right-angle turns without jockeying.

Here is a real production booster where work space is limited. The TL-6 is ideal for unloading boxcars, traveling through narrow aisles and doorways, making hairpin turns near columns and posts. Has short, 6½-ft turning radius . . . over-all length only 9 ft, 7 in., width 4 ft, 5 in.

You get big loads fast and you carry them low. Torque converter drive eliminates engine stalling . . . crowding is positive and smooth. Bucket has scooping action — tips back 22° at floor level. Reaches carry position, 50° tip-back, at only 3 ft above floor — means easier maneuvering, greater stability, better visibility.

As for ease of handling, operators say it's the best yet. Forward and reverse are controlled by a single, smooth-working lever — no gear shifting necessary. Reverse is twice as fast as forward — lets you get away from the pile "on the double."

Ask your Allis-Chalmers Industrial Tractor Dealer to show you the TL-6 or the two larger Tracto-Loaders in action.

For bigger, tougher jobs, see the Tractomotive TL-10 Tracto-Loader

— the industrial wheel loader that proved the soundness of Tracto-Loader design. It set new standards in loader performance with a combination of hydraulic torque converter drive and clutch-type transmission. Has 63-brake hp, 1-cu-yd bucket. Various interchangeable attachments.

Sold and Serviced by your Allis-Chalmers Industrial Tractor Dealer

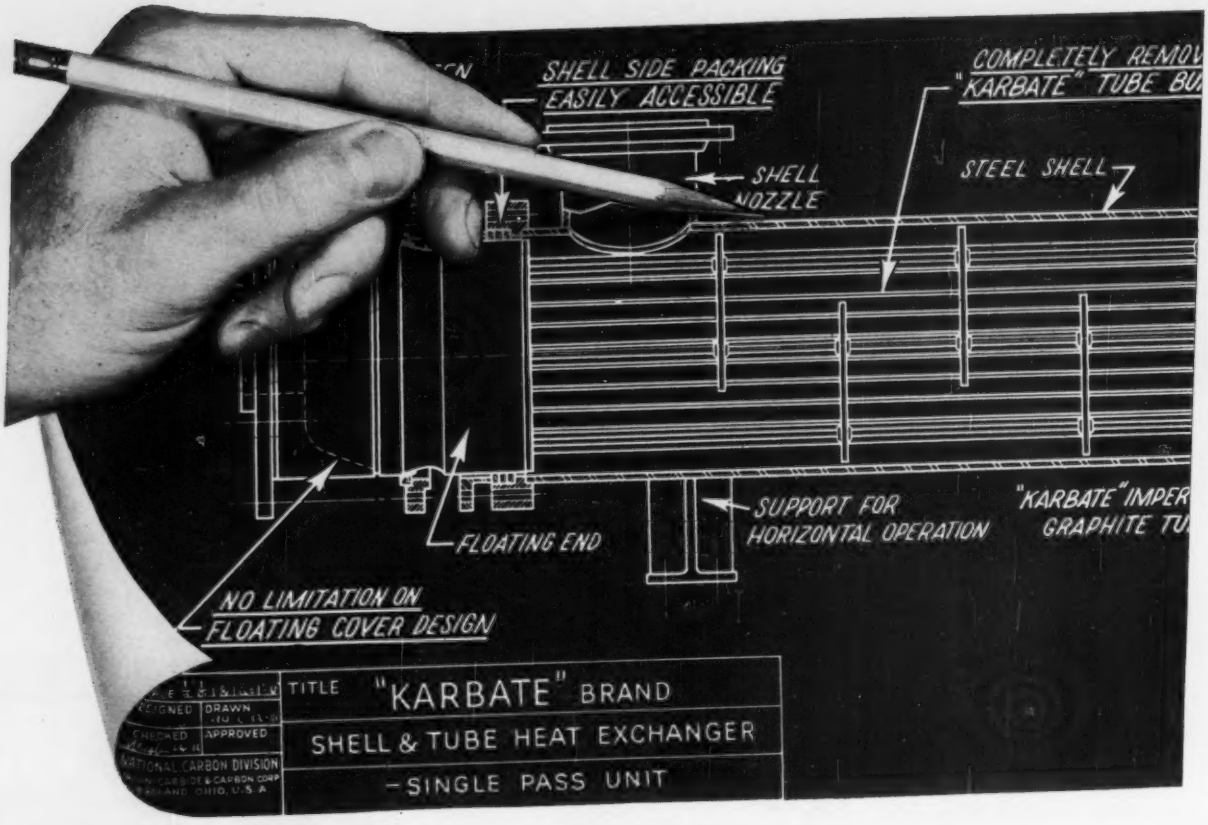
TRACTOMOTIVE

Tracto-Loaders • Tracto-Shovels • Side Booms and Hydraulic Rippers for Allis-Chalmers Crawler Tractors • Loader and Shoulder Maintainer for Allis-Chalmers "D" Motor Grader

TRACTOMOTIVE CORPORATION • Deerfield, Illinois

ANNOUNCING...NATIONAL CARBON'S COMPLETE LINE OF

"KARBATE" IMPERVIOUS BRAND



HERE'S WHAT YOU GET WITH "KARBATE" STANDARD HEAT EXCHANGERS:

- **LOWER FIRST COST**... through quantity production
- **MORE AREA PER UNIT**... to 2300 square feet per tube bundle
- **CHOICE OF TUBE LENGTHS**... 6, 9, 12, 14, 16 feet
- **FASTER DELIVERY**... from extensive factory stocks

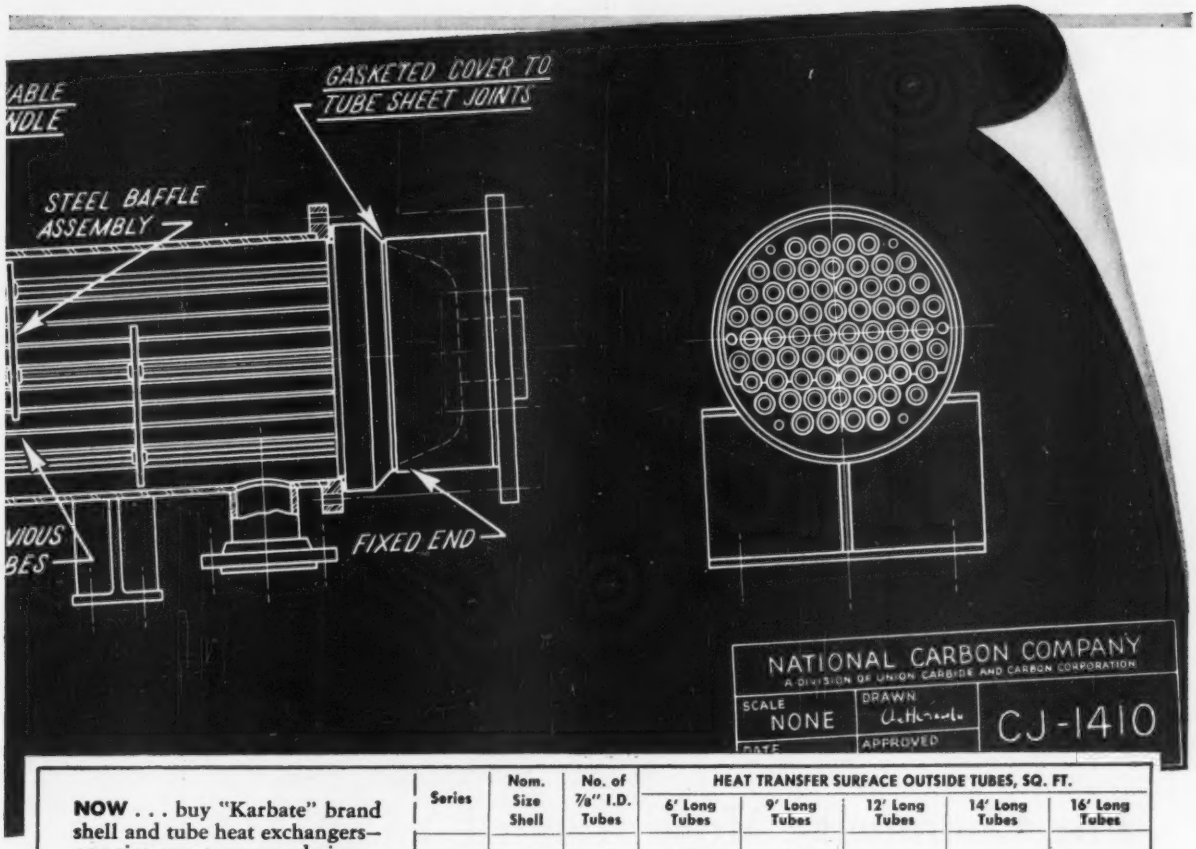
...and all the advantages of "Karbate" Impervious Graphite, including:

- **COMPLETE CORROSION RESISTANCE**
- **HIGH THERMAL CONDUCTIVITY**
- **IMMUNITY TO THERMAL SHOCK**

Engineered for maximum corrosion resistance and minimum maintenance, these shell and tube heat exchangers are so constructed that all surfaces in contact with the corrosive fluid are of "Karbate" brand impervious graphite. Their mechanical design, proved in years of service, utilizes the material's high compressive strength to assure ruggedness beyond the toughest operating requirements.

Always consider "Karbate" brand impervious graphite. Take full advantage of this versatile material by including "Karbate" heat exchange equipment in every estimate where corrosion-resistance is a factor. And when you do this, you'll be pleasantly surprised at the cost comparison with heat exchangers of materials having far less effective resistance to corrosion.

GRAPHITE HEAT EXCHANGERS



NOW . . . buy "Karbate" brand shell and tube heat exchangers—any size, any type, any design—directly from National Carbon, pioneer and leader in the field of corrosive heat transfer.

Components of all sizes of "Karbate" Brand Heat Exchangers are manufactured in quantity and carried in stock. You save money...you save time...when you specify "Karbate" Brand Shell and Tube units.

Series	Nom. Size Shell	No. of 7/8" I.D. Tubes	HEAT TRANSFER SURFACE OUTSIDE TUBES, SQ. FT.				
			6' Long Tubes	9' Long Tubes	12' Long Tubes	14' Long Tubes	16' Long Tubes
90	6"	9	17.7	26.5	—	—	—
310	10"	31	—	91.2	121.6	141.9	162.2
420	14"	42	81.7	123.3	164.8	192	220
640	16"	64	124.3	187.7	251	293	335
850	18"	85	165.2	250	334	389	444
1090	20"	109	213	320	427	499	570
1350	22"	135	263	397	530	618	706
1630	24"	163	317	479	640	746	852
1950	26"	195	379	573	766	892	1017
2330	28"	233	453	684	914	1166	1217
2680	30"	268	521	786	1051	1225	1400
3490	34"	349	679	1024	1368	1595	1822
4390	38"	439	855	1289	1722	2009	2295

"KARBATE" BRAND IMPERVIOUS GRAPHITE IS MANUFACTURED EXCLUSIVELY BY NATIONAL CARBON COMPANY

Remember, whenever you are buying corrosion resistant heat exchangers, that it will pay you to get our proposal on "Karbate" brand Heat Exchangers!

•

The term "Karbate" is a registered trade-mark of Union Carbide and Carbon Corporation

NATIONAL CARBON COMPANY
A Division of Union Carbide and Carbon Corporation
30 East 42nd Street, New York 17, N. Y.

Sales Offices: Atlanta, Chicago, Dallas, Kansas City, Los Angeles, New York, Pittsburgh, San Francisco
IN CANADA: Union Carbide Canada Limited, Toronto

IMPERVIOUS GRAPHITE
KARBATE
TRADE-MARK
PROCESS EQUIPMENT
NATIONAL CARBON COMPANY
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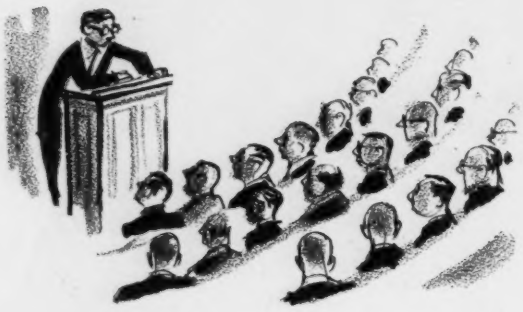
WRITE FOR NEW CATALOG SECTION 5-6800

1960 Outlook for . . .



Inorganics

	1954	1960
	Output, Million Dollars	
Sulfuric acid	320	400
Ammonia	230	288
Phosphoric acid	200	250
Caustic soda	180	225
Chlorine	170	212
Soda ash	150	188

Plastics

	1954	1960
	Consumption, Million Lb.	
Vinyls	950	2,676
Polystyrene	609	1,408
Polyethylene	210	627
Phenolics	401	522
Ureas and melamines	236	340
Cellulosics	120	144
Acrylics	60	80
Polyesters	26	60
Epoxies	23	82
Nylon	15	45
Alkyd molding materials	6	9
Fluorocarbons	1.5	6

Organics

	1953	1960
	Million Lb.	
Cyclic intermediates, output	4,699	10,000
Synthetic dyes, sales	152	170
Lakes and toners, output	44	66
Flavor, perfume materials, output	34	60
Rubber chemicals, output	145	230
Plasticizers, output	293	470
Miscellaneous cyclics, output	402	.....
Miscellaneous acyclics, output	17,267	33,000

For Chemicals: More Record Years Ahead

The chemical industry, like most of the economy, looks for at least five more fine years. Though some growth rates are slowing, confidence abounds.

Good times for chemicals are far from over.

That's the overwhelming impression we got listening to a day-long symposium on what's ahead for chemicals in 1960 at the latest Chemical Market Research Assn. meeting. Certainly not all products will boom, but in general growth will be sure and better than just steady.

Forecasters* pictured six major chemical groups against a background of an over-all 1960 economy with a gross national product of $420 billion, compared with $357 billion last year, and a population rise from 164.5 million in 1955 to 177 million in 1960.

* These are the men who went out on limbs to predict the 1960 chemical economy: *General Economic Outlook*, Dexter M. Keezer, McGraw-Hill; *Chemicals for Agriculture*, Richard F. Messing, Arthur D. Little, Inc.; *Organic Chemicals*, Shea Smith, 3rd, Monsanto; *Synthetic Fibers*, Manfred Keller, Du Pont; *Drugs and Pharmaceuticals*, Edmund R. Swanberg, Scudder, Stevens & Clark; *Plastics*, Gordon Brown, Bakelite; *Inorganic Chemicals*, Edwin M. Ott, Penn-Salt; *Economic Implications of Chemical Growth*, Robert C. Miller, Stanford Research Institute.

▶ Organics: Way Up—Except for dyes, organic chemicals are in for healthy years (*table above*). But listeners were cautioned that the tremendous amount of research being done may well make all these predictions grossly low.

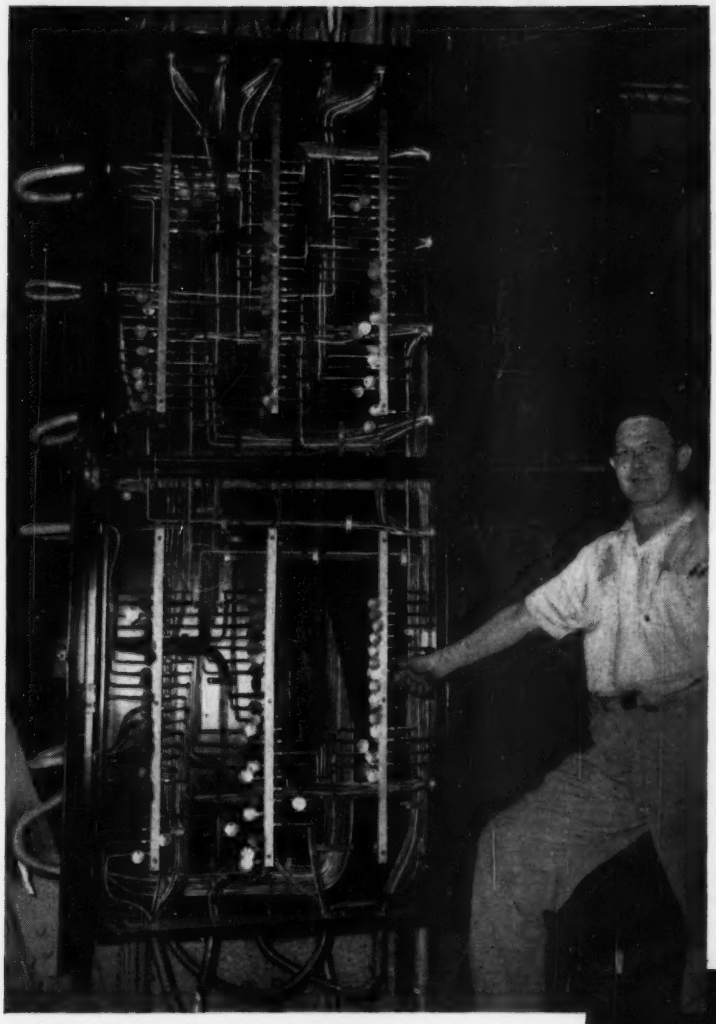
Among cyclic intermediates, styrene, phthalic anhydride and phenol are growing very fast. Phthalic and phenol should keep right on going, but styrene is expected to level off, even though synthetic rubber will capture more of the total rubber market.

No great hope is held out for dyes, mostly because per capita fiber consumption won't rise much. One exception may be household dyes—up 50% from 1949 to 1952.

(*Continued*)

FOR INSTRUMENTATION AND CONTROL

Cabled Tube



Some time ago Revere ran an advertisement featuring Crescent Armored Multitube for use in pneumatic and hydraulic instrumentation and control systems. The advertisement created so much interest that we thought you might like to see a photograph of an actual installation. The Control Board Junction Box shown here has 22 runs of Multitube coming into this box comprising 224 Revere Copper Tubes of 1/4" O.D. The picture was taken in the Glenwood Landing, N.Y. Power Station of the Long Island Lighting Company. The tubes go to instruments that report information on temperature, main and reheat steam pressure, boiler feed and condensate pump pressure, fuel oil and gas pressure, liquid levels, tide level and for the control of fuel feed, draft dampers, boiler drum water level and various control valves.

This is a relatively new use for Revere Copper Tube, but it is an important one in these days when new ways are being found to obtain process information more quickly and accurately, or to achieve automatic control. Crescent Armored Multitube is made by Crescent Insulated Wire & Cable Co., Inc., Trenton 5, N.J., in lengths up to 1,000 feet. It consists of a group of long tubes twisted together in cable form, protected by a flexible interlocked galvanized steel armor, or by plastic, or both. As many as 19 tubes, 1/4" O.D., can be cabled, with one tube in each layer color-coded. Larger tubes can also be cabled, including 5/16", 3/8" and 1/2". This construction affords protection during shipment, installation and use, and speeds up installation greatly. For further information, write Crescent, and for tube in copper and aluminum, see the nearest Revere Sales Office.

REVERE

COPPER AND BRASS INCORPORATED

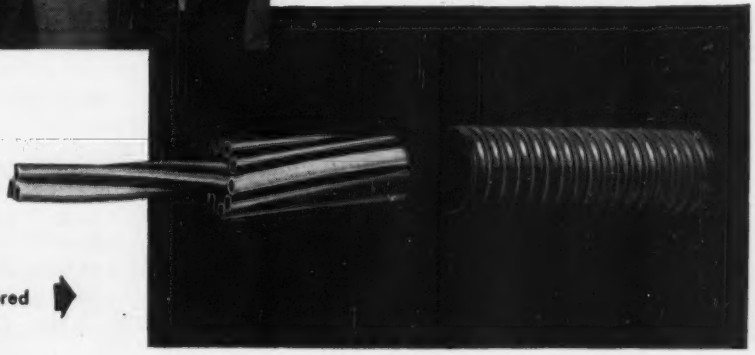
Founded by Paul Revere in 1801

230 Park Avenue, New York 17, N. Y.

• • •

Mills: Baltimore, Md.; Chicago and Clinton, Ill.; Detroit, Mich.; Los Angeles and Riverside, Calif.; New Bedford, Mass.; Rome, N. Y. Sales Offices in Principal Cities, Distributors Everywhere.

Control Junction Box at Power Station of Long Island Lighting Company, showing use of Crescent Armored Multitube. Note that relatively sharp bends can be made without damage to the cabled copper tube.



Construction of Crescent Armored Multitube.

Lakes and toners are expected to rise about 50%, with two factors predominating: More do-it-yourself painting and generally greater interest in more and brighter colors.

Flavors and perfumes go mostly into luxury items and that outlook is excellent. (Per capita post-tax income in 1954 was $1,561, by 1960 will hit $1,730.)

Rubber processing chemicals will continue to grow faster than rubber, largely because synthetic rubber will get a bigger part of total rubber sales. But product obsolescence will be high.

Plasticizers are expected to lose some markets because of internally plasticized resins. But the inherent growth of plastics should give plasticizers strength for many years. Again, product obsolescence will be rapid.

For surfactants, increased use of detergents will keep growth high until about 1965. However, growing industrial uses indicate that detergent use is not the ceiling for surface active agents.

Miscellaneous cyclics have about doubled since 1950 and will have big growth, particularly in lube oil and gasoline additives. Miscellaneous acyclics, largely the much-talked-of petrochemicals, will likely rise 90% by 1960.

▶**Inorganics: Up but Slower**–1954 production value of this group was about $2.5 billion. The six leaders accounted for roughly about half (see *table*, p. 254).

Since 1945 these six have grown at a remarkably consistent rate of about 12%. But the end of war-created shortages, Korea and unusual population increases should slow growth. About 25% higher is probable for 1960, though it's unlikely that all six will hold right to that trend.

▶**Synthetic Fibers: Mixed**–Prediction for manmade fibers are of two sorts: good for noncellulosics, not so good for cellulosics. Total sales in 1960 will be about 1.8 billion lb.—up 20% from 1954. But cellulosics will be only 950 million lb.—down 18%—while the other synthetics will climb to 850 million lb.—up 150%.

The only major fibers up in per capita use are noncellulosics. These fit well into today's textile market, which has shifted from mass production to bringing customers what's new, what saves time and what makes life more attractive. The key to fiber forecasting, as never before, is to watch the consumer, while keeping an alert eye on technology changes in both types of fibers and uses.

▶**Plastics: Still Zooming**–For the 12 major plastics, output by 1960 will rise 130% (see *table*, p. 254). Some, like vinyls and polyethylene, will take mammoth strides. Others, like cellulosics and acrylics, will move much slower.

The figures for vinyls are inflated by coating resins. In 1954, 26.5 million lb. was vinyl acetate paint; in 1960, 661 million lb. is the same paint—20% resin solids. But even excluding these, growth is huge. Biggest rises will be in surface coatings, wire coating, flooring and coated fabrics. Film, which suffered severe reversals recently, should experience big growth.

Polystyrene is also inflated by coating resins—300 million lb. in 1954, 950 million in 1960. Styrene has suffered in both toys and housewares because poor design generated consumer enmity. But these markets will grow in the next five years through more use of rubber-modified styrenes.

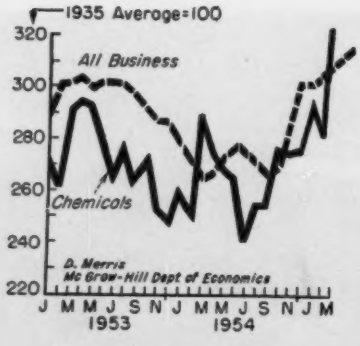
The polyethylene forecast is much less optimistic than most we've seen recently. Actually, it indicates that just the plants now being built will give over-capacity in 1960. Still, growth will be spectacular, though it will require many specially tailored polyethylenes, not just today's relatively simple ones.

Phenolics, though outmoded in some outlets, are finding enough new uses, such as microballoons and shell molding, to keep rising modestly.

Urea resins will grow about 30% by 1960, while melamines, which still have a big potential in dinnerware alone, will probably double. For acrylics, one use that should jump by 50% in five years is molding powders.

The low-volume plastics, except for alkyd molding materials, are all in for big percentage increases. Long-range estimates for the somewhat overpublicized polyesters have been cut back. Epoxies will continue to find their biggest outlet in coatings and adhesives, though use as a component in resin mixtures is also in for a big boost. Fluorocarbons, despite many unique

Consumption Index



Business Activity (May).....315.5

Chemical Consumption April (Prelim.).314.54

March (Rev.).....321.7

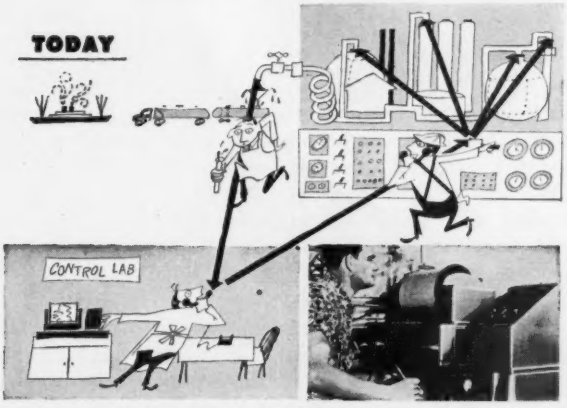
Indexes	April	March			
Fertilizer	78.12	76.33	Paint & varnish...	32.49	32.06
Pulp & paper	34.82	36.42	Textiles	10.36	11.52
Petroleum ref. ...	27.66	29.73	Coal products	12.24	12.40
Iron & steel.....	18.00	18.31	Leather	4.69	4.73
Rayon	30.79	33.15	Explosives	9.02	8.46
Glass	25.16	25.37	Rubber	7.19	7.72
			Plastics	24.00	25.53

Analysis Moves from Lab to Line

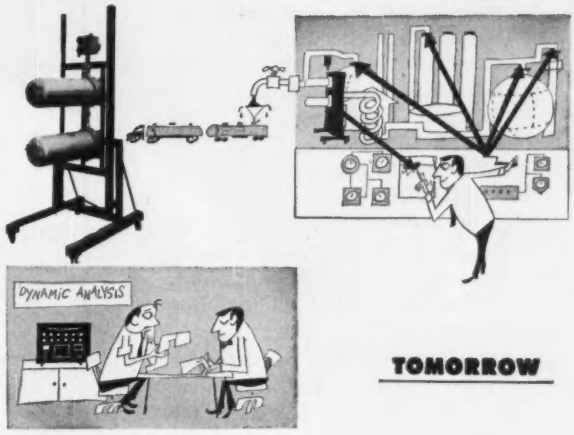
The pride of the automation proponents is the chemical processing plant. Carloads of materials flow through its complex network of pipes into gleaming fractionation columns, purification towers and reactors with a minimum of human attention. Equally large amounts of finished product flow outward without ever having been seen by human eyes.

This complex system functions smoothly thanks to the hundreds of control instruments in any processing plant. They control material flow, they provide the correct temperature and pressure to produce the highest product yield. These plants represent our closest approach to the automatic factory.

But in this system there are flaws. For even when all dials and gages are functioning correctly, the product yield in terms of quality and quantity may be completely awry. These instruments will not indicate changes in raw material composition, catalyst contamination, or loss of efficiency in a scrubbing tower. Present-day instruments indicate only the process stream environment, not the composition of the process itself. Only the control laboratory is able to give us an accurate picture of the product and its composition as it moves through the plant. Subtle deviations in the product can be spotted and analyzed, and from the control laboratory instructions can be forwarded to process areas prescribing changes in control instrument settings. Thus, true control in today's processing begins in the analytical laboratory.



But efficient as they are, control laboratories still represent a bottleneck in the processing chain. It takes time to move a sample to the laboratory, analyze it, and relay findings back to the plant. Meanwhile, vast quantities of product may have moved through the processing units.



An obvious solution is to move the laboratory to the problem, i.e., tie an analytical instrument like the infrared spectrometer directly into the process stream where it can produce continuous and instantaneous data. Instruments capable of providing such "on-stream analytical control" are just beginning to appear. They will not replace existing environmental controllers but they do provide the means for automatically controlling these instruments to meet changing process stream conditions. They close the loop between the product and the process stream environment in which it is produced.

Two such on-stream analyzers are already in production by Perkin-Elmer and are being used in the field. Known as the Bichromator and Tri-Non Analyzers, each has its use depending upon the particular problem to be solved. While the most obvious application for such analyzers is to monitor the finished product, in a complicated chemical process where there are many variables, end point analysis does not provide sufficient control information. Hence, it is found advisable to install instruments at several critical points in the process. Such analyzers will soon make true automation a reality in chemical processing.

Digest of an article from *Control Engineering*, Oct., 1954.
Reprints available from Perkin-Elmer on request.

THE PERKIN-ELMER CORPORATION, NORWALK, CONN.
First in Analytical Control

properties, are still handicapped by high price ($8.50/lb.).

▶**Drugs: Hard to Pinpoint**—Improved standards of medical care, general population growth and growth of the over-65 age group all favor continuing growth of drugs and pharmaceuticals. But price cutting and high rate of product obsolescence make it nearly impossible to predict an actual dollar volume for 1960. Long-range drug forecasting has often been woefully inaccurate—1951 forecasts called for $2 billion in sales by 1955; actual 1954 sales were only about $1.54 billion.

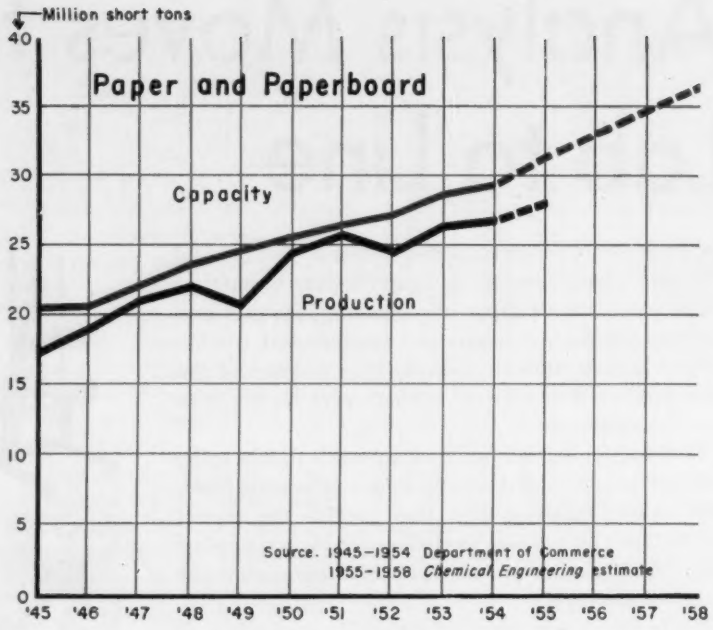
Average dollar growth since 1947 has been about 8½% annually. But from 1951 to 1954 it was only 2-3% a year. Much of this drop came from vicious price competition in antibiotics. Barring more of that, though, and anticipating a reasonable flow of new drugs, the industry should grow steadily at least through 1960.

▶**Fertilizers: 1:1:1:**—Even if farm prosperity doesn't rise much by 1960, there are good reasons for predicting continued fertilizer growth: Only 25% of U. S. crop land gets any fertilizer now; most usage is well below optimum. Balancing these, of course, is farmer resistance which must be overcome by intensive education from industry and government groups.

Best estimates for growth through 1960 are annual increases for nitrogen of 150,000 tons, for phosphates of 125-150,000 tons, for potash of 150,000 tons—essentially a 1:1:1 ratio instead of the recent 1:1.2:1. The trend toward higher analysis materials seems certain to continue, as will the growing use of direct application of anhydous ammonia.

One danger point is U. S. ammonia capacity, which will be at 3 million tons by the end of 1955 and at 3.8 million tons a year later. Already producers are running below capacity part of the year and the surplus condition will likely become more acute.

But generally, the fertilizer industry, like the chemical industry as a whole, is in for at least five more excellent years.



Optimism Lights Paper

Record first-quarter production points to another bonanza year for pulp and paper. Viewed against 1954's record output it highlights paper's basic strength.

Calvin S. Cronan, Associate Editor

Based on first-quarter paper and paperboard output of 7.2 million tons, the paper industry expects 1955 to hit an all-time high of 28 million tons, according to the American Paper and Pulp Assn. It will be the fourth year in the last five that the industry has posted new highs in total output. And it firmly establishes pulp and paper as the nation's No. 4 industry.

Increased output this year can be traced largely to improved demand for paperboard, building board and newsprint.

During 1954 over-all production of paper and paperboard just nosed out 1953's record 26.5 million tons to post a new record of 26.7 million tons. Actual consumption during the year was 31.8 million tons, as imports, mostly newsprint, supplemented domestic production. Few, indeed, were the other major U. S. industries, durable or nondurable, that showed gains in the face of the general business decline.

First quarter report by the U. S. Pulp Producers' Assn. shows total pulp production of about 4.9 million tons, a 0.5 million ton gain over the first quarter last year. However, the 1954 first quarter output rate lagged behind the average rate for the year.

As a whole, 1954 toted up 18.3 million tons of wood pulp production, up 4.6% over 1953.

▶**New Plants**—The solid gains made by our pulp, paper and board industry are rooted in a broadening productive base as new facilities come into operation. Total U. S. paper and board capacity was expanded last year by one million tons—to a year-end level of

C&I

THE CHEMICAL AND INDUSTRIAL CORP. • CINCINNATI 26, OHIO

29.2 million. Although gigantic by any standards, this growth was a step down from 1953's peak of 1.5 million tons added.

This year you can expect paper and board capacity in this country to rise by another million tons, though earlier in the year it looked like the increase would not be nearly so great.

Last January the American Paper and Pulp Assn. announced results of a survey of planned new paper and paperboard capacity for 1954-1960. The survey also tried to establish an industry-wide base capacity for 1953 (see *table*). The entire industry was covered, either directly or indirectly, and indications at that time were for a total increase of only 1.25 million tons for 1955-1960—little more than 4% over 1954.

A more recent survey (by McGraw-Hill, *Chem. Eng.*, June 1955, p. 326), however, reflects the new booming optimism of the whole economy and of paper makers in particular. The whole pulp, paper and allied products industry, of which paper and paperboard is just a segment, now plans to increase total capacity by 24% in 1955-1958—7% in 1955 alone. Planned expenditures for 1955 are $501 million, compared with $455 million last year. For 1956-1958 spending already planned totals $1.12 billion. And historically, manufacturers tend to be conservative on long-range plans.

Beyond 1960, steady growth will undoubtedly prevail. Stanford Research Institute in an outstanding study, "America's Demand for Wood, 1929-1975," made for Weyerhaeuser Timber Co., charts growth for the next 20 years. Over the span 1952-1975 total domestic paper and paperboard is slated to nearly double—from 24.4 to 46.6 million tons.

► **Newsprint in the Limelight**—From a 1944 low of 0.7 million tons, domestic newsprint output rose last year to 1.2 million tons, the highest since 1931. We now have three large newsprint mills in the South. Another one's been announced by the Southern Newspaper Publishers Assn. and an expansion is already planned for the new Bowaters mill at Calhoun, Tenn., which started up only last year. And in Maine, Great Northern Paper has a new plant that utilizes hardwoods for newsprint through the chemigroundwood process (*Chem. Eng.*, Feb. 1955, p. 126).

Nationwide, the newsprint situation is healthier as growing domestic output makes us a bit less dependent on our one source of supply, Canada. While we still import a major share of our newsprint from Canada we actually exported 140,000 tons last year, a threefold increase over 1953.

► **Self-Service Boom**—Utilitarian outlets such as packaging probably have promoted recent paper consumption rises more than cultural or printing uses. The annual review, "Pulp, Paper and Board," issued last March by the Business and Defense Services Administration, indicates that general commodity distribution appears to be the stage-setting for the next era of major change in packaging.

What has taken place in packaging to fit super-market needs may well extend to other merchandising. It could mean individual paper packages for such items as men's ties, shirts or socks; women's hose, underwear or handbags; household necessities, hardware, etc. Should self-service retailing extend to these products nationally, per capita consumption of paper and board would rise proportionately. All this would reflect in growing demand for bleached sulfate pulp.

Despite this growth outlook, the pinch of competition is being felt increasingly in the packaging market. Films, foils and plastics are grabbing a healthy slice of the business.

To offset this impact on earnings, companies are increasing their penetration into the chemical industry. Production of tall oil and lignin derivatives is booming. St. Regis Paper recently entered the molded plastics field. And International Paper has acquired Commercial Alcohols, Ltd., a Canadian alcohol firm that doubles in specialty chemicals and insulation.

► **Integration Spreads**—Diversifying into chemicals is just one trend. Faced with rising costs in capital investment, labor and transportation the industry is moving toward greater integration. There is even evidence of gradual changeover to a broad forest products industry.

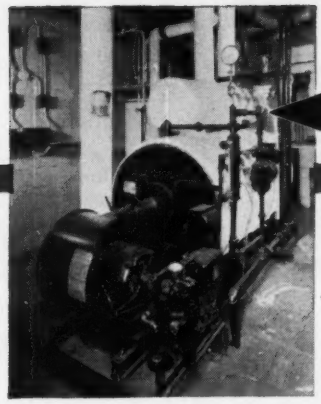
Crown Zellerbach, for instance, is going into plywood production. Utilization of mill waste sawdust and slabs for production of pulp has grown to a sizeable tonnage operation and should keep growing. Chemical byproducts derived from waste liquor, bark, etc., are opening up new markets. (*Continued*)

U. S. Paper Capacity: Growing Steadily

(Estimated at year-end, thousand tons, 310-day basis)

	1953	1954
Newsprint	1,076	1,272
Book and groundwood	3,840	3,898
Fine	1,355	1,428
Coarse	3,461	3,479
Tissue	1,732	1,788
Special industrial and absorbent	716	736
Building paper	1,420	1,420
Total paper	13,600	14,021
Container board	6,569	7,038
Bending and nonbending board	4,975	5,075
Cardboard and special stock	1,289	1,280
Wet board	229	237
Building board	1,536	1,538
Total board	14,598	15,168
Total paper and board	28,198	29,189

Source: American Paper and Pulp Association



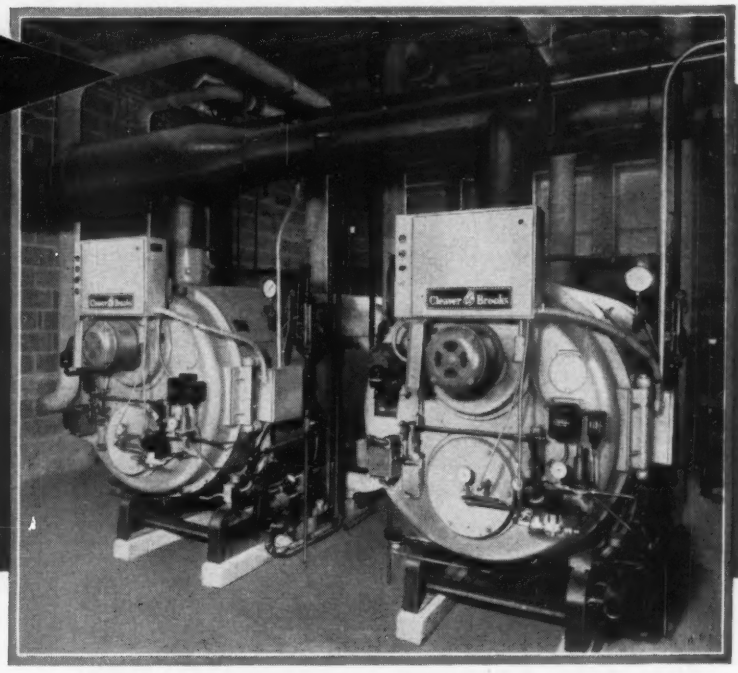
1931

Cleaver-Brooks pioneers big steam capacity in small space

This veteran 20-hp heating boiler — built by Cleaver-Brooks and installed in 1931 — is still in daily use. It is proof of the dependable service you can expect from Cleaver-Brooks' famed four-pass, self-contained boiler construction for any heating or processing need.

1955

Cleaver-Brooks is first again with the *ALL NEW* "CB" boiler



- **All main burner components are completely integrated for automatic operation.**
- **More boiler capacity in less space through elimination of extended burner assembly platform.**
- **Guaranteed 80% efficiency — Four pass construction. 5 sq. ft. of heating surface per bhp.**
- **11 sizes — 79 models — 15 to 150 hp, (steam or hot water) for oil, gas or combination oil/gas use. Other models available through 600 hp.**
- **Complete (Boiler-Burner) unit approval by Underwriters Laboratories — conforms to ASME codes. Factory tested before shipment.**

The "CB" is the most easily maintained package boiler on the market. Removal of only nine bolts (on the largest sizes) opens hinged doors for fast inspection, cleaning or service. This convenience has earned widespread praise of insurance firms.

BOILER users will quickly appreciate the surprisingly silent operation of the new forced-draft "CB" — *with the fan mounted inside the front hinged door.* Design avoids use of thin sheet metal housings and usual "chattering" and vibration.

Even greater combustion efficiency is yours with the new "CB" air-atomizing burner, with integral air compressor. All burner components are confined to the front head and the control panel is at operator eye level.

For complete facts on the boiler that's ahead in design, performance and economy, write: Cleaver-Brooks Company, Dept. J, 345 E. Keefe Ave., Milwaukee 12, Wis., U.S.A. Cable Address: CLEBRO — Milwaukee — All Codes.

Write for copy of latest "CB" Boiler Bulletin covering your size requirements — contains specification data to help you plan.

Cleaver Brooks

Originators of the self-contained boiler

Aside from these more spectacular trends there is increasing diversification within existing product lines. Mills producing mass grades are moving into specialty grades, long the dominion of independent, nonintegrated mills. How well the independents meet this challenge rests on their ability to modernize plant facilities.

►**Exports Grow**—In retrospect, 1954 was the first year the U. S. industry showed much interest in foreign markets. Not only did exports increase, but there was activity in forming branches overseas.

Significantly, pulp exports have grown faster than paper exports because pulp is on tariff-free lists. Leading the pulp export list in growth is dissolving pulp, up from 61,000 tons in the first quarter of 1954 to 164,000 tons in the same period of 1955. Bleached grades of kraft are experiencing growing demand, too, as U. S. packaging methods catch on in foreign lands.

So right down the line, pulp and paper shows sufficient strength to warrant predictions from some quarters that it bids fair to climb even higher than No. 4 among the nation's industries.

GUIDED TOUR CONTINUED

PICTURED FLOWSHEET

Fluidized Bed in Sulfuric Acid Plant 288

NAMES IN THE NEWS

William P. Drake, new president of Pennsylvania Salt Manufacturing Co. 297

Names that made news last month 296

TECHNICAL BOOKSHELF

Newcomers for your reference shelves 306

Recent books & pamphlets 310

FIRMS IN THE NEWS

Who's doing what among your suppliers 314

TECHNICAL LITERATURE

Manufacturers' new literature 422

COMING SOON

How to analyze your maintenance costs . . . . . Sept.

New data leads to better hopper design . . . . . Sept.

Get started in your professional development . Sept.

Novel furnace design for severe conditions . . . Sept.

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Bio-oxidation of process wastes: A report . . . . Sept.

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Now, H_2SO_4 by fluidization

Anaconda uses the fluidized bed technique to make acid from low-grade sulfur ores. This new 450-ton contact plant is the first of its kind. (p. 288)

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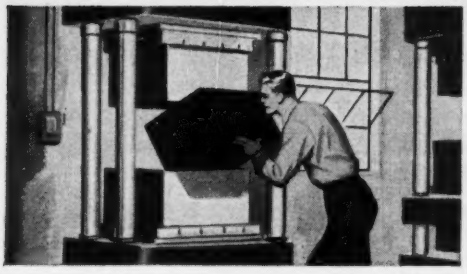
Inside Back Cover

For product improvement . . . for production efficiency

FIND THE ANSWER

. . . with Celanese* Chemicals

Even backyard gardeners know how well hormone weed killers attack crabgrass. But the farmer has reaped the most from this chemical spray, in time and labor saving, and in increased crop yields. ACETIC ANHYDRIDE—a major ingredient in herbicides—is one of the acetyl chemicals which Celanese produces in volume, and whose uses Celanese has helped to develop over the years.



The plastics industry is meeting the tremendous demands for television parts—from cabinets to control knobs—with highly efficient low-cost mass molding methods. By making FORMALDEHYDE available in four specialized forms for the production of the plastic resins, Celanese is contributing to an outstanding industry-wide record for performance.

Today's "horn of plenty" for industry lies deep below the earth's surface, where trillions of cubic feet of natural gas represent a virtually inexhaustible supply of hydrocarbons.

Celanese Corporation of America has based its integrated petrochemical operation on this vast storehouse of natural wealth, employing specially developed processes to synthesize organic chemicals for use in nearly every major field of production. It is an operation that can supply industrial materials of greater uniformity, higher purity and improved reactivity. It can offer manufacturers the continuity and selectivity they are looking for from their basic supplier. When your production problem is chemical—and basic—Celanese organic chemicals can be the answer. Celanese Corporation of America, Chemical Division, Dept. 553-H, 180 Madison Avenue, New York 16, N. Y.

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Aldehydes
Anhydrides
Esters
Glycols
Hydraulic Fluids
Ketones
Oxides
Polyols
Plasticizers
Salts
Solvents
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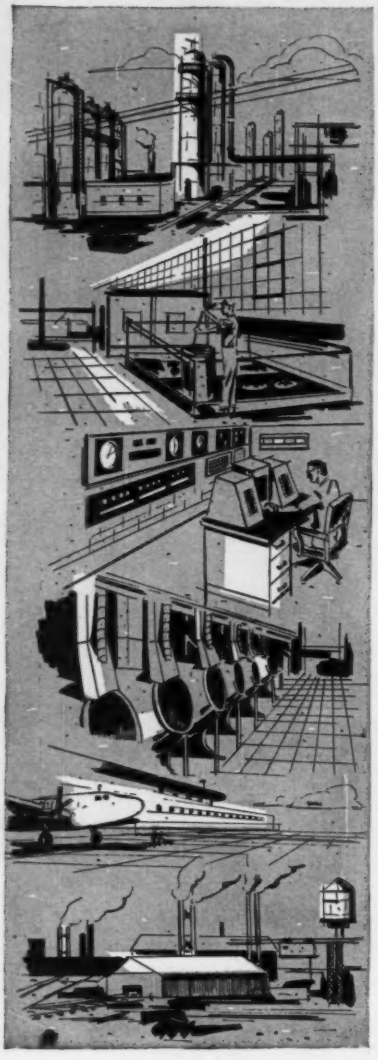
In textiles, plastics, agriculture, paper, surface coatings, electrical and building materials and equipment, pharmaceuticals.

A MESSAGE TO CONSULTING ENGINEERS

Have you noticed how frequently you're being asked for recommendations on DRYing? For example, if your specialty is one of these:



PETRO-CHEMICAL—Extreme DRYness is often required for the air, gases and organic liquids involved in processes . . . a moisture content of 3 to 4 parts per million, or less. Otherwise, reactions are likely to go wrong and product quality suffers.

METAL-WORKING—DRY controlled atmospheres are necessary in many heat-treating and sintering operations. Metals must be stored, parts inspected and assembled in DRY rooms to prevent corrosion. Costs are correspondingly lower.

POWER GENERATION—Pneumatic controls must be fed DRY air to prevent freeze-ups and clogging of delicate instrument ports. Control rooms are dehumidified to improve performance. The hydrogen that cools generators is kept DRY to safeguard their electrical insulation.

PHARMACEUTICAL—Areas in which hygroscopic materials are handled, whether they're tiny cubicles or complete workrooms, must be kept DRY. 10% relative humidity is common in industry. Precautions must be taken to prevent leakage of moisture into these areas and maintain this DRYness.

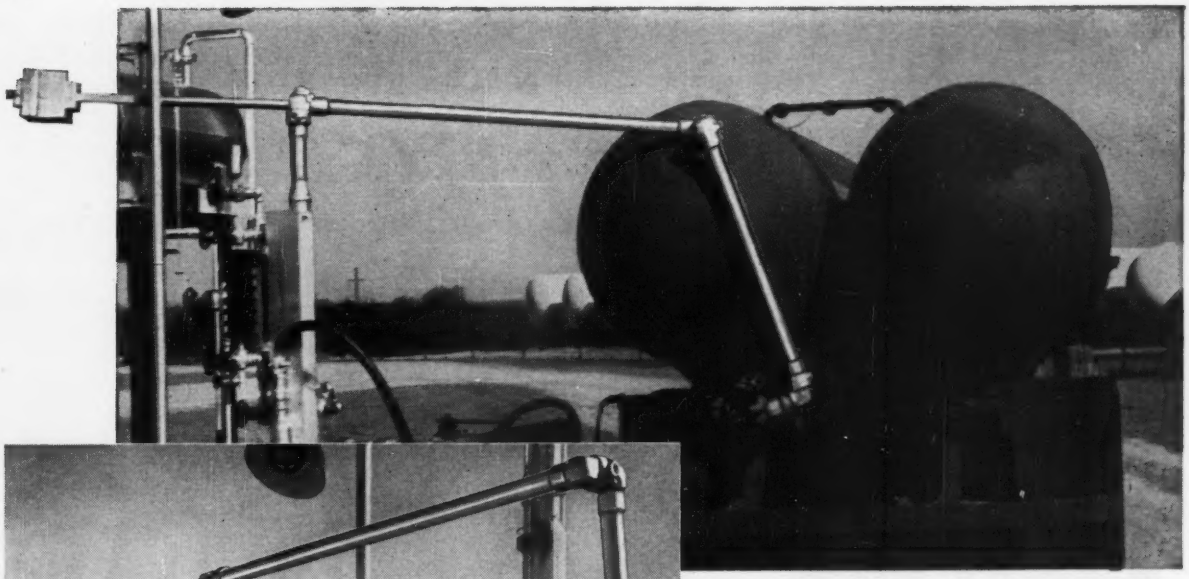
AIRCRAFT—Flight conditions at stratospheric heights in frost-free air must be simulated for airplanes, components and missiles. Wind tunnels and altitude test chambers must operate, therefore, at dewpoints below −100°F.

GENERAL INDUSTRY—Foodstuffs and jet engines have this in common: both are packaged in DRY inert atmospheres to prevent their deterioration. Wherever moisture is a hazard, it can probably be eliminated or held to a known, predictable constant. DRYing, then, becomes a matter of economics, balancing costs against gains.

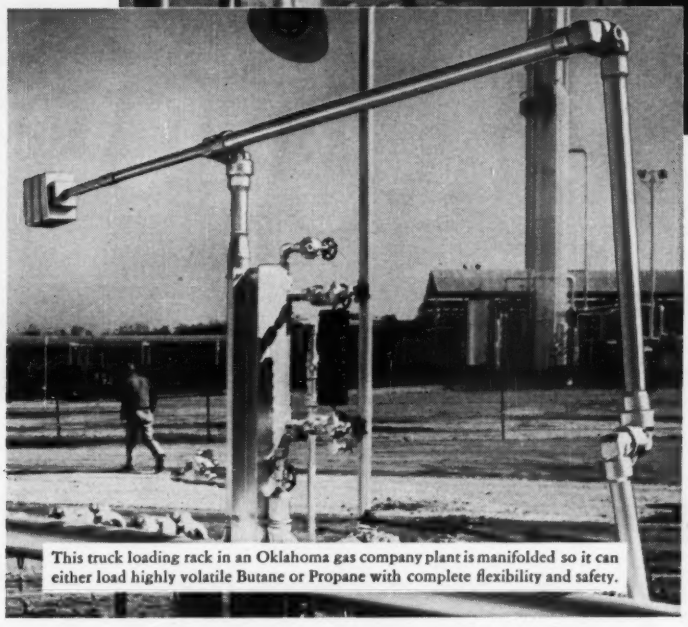
Make someone in your organization an expert on DRYing . . .

Be prepared for these requests when they come in. You select the man and we'll gladly assist in his education. Send us his name and we'll send him the book, *Because Moisture Isn't Pink,* and other data. Pittsburgh Lectrodryer Corporation, 303 32nd Street, Pittsburgh 30, Pennsylvania.

PITTSBURGH LECTRODRYER CORPORATION



The truck loading rack illustrated here is made up of one 2", Style 50, one Style 40, one Style 50x5 high pressure steel Chiksan swivel joints, and one 1" Style 20 high pressure steel joint.



This truck loading rack in an Oklahoma gas company plant is manifolded so it can either load highly volatile Butane or Propane with complete flexibility and safety.

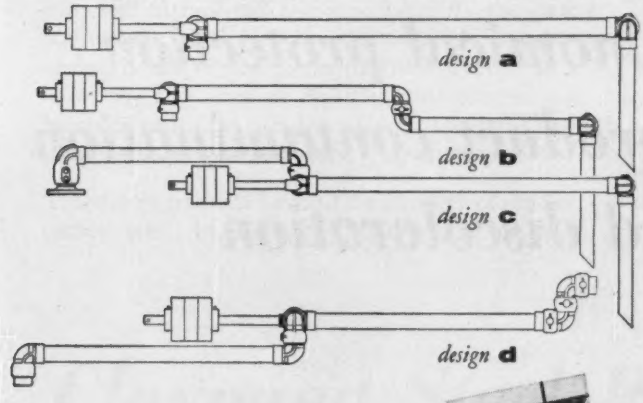
CHIKSAN adds Safety and Speed to Truck or Tank Car Loading of Gas or Chemicals

CHIKSAN provides the necessary liquid-tight, gas-tight connections, the characteristic flexibility of motion to keep volatile Butane and Propane or chemicals flowing swiftly with safety, economy and convenience.

Loading and unloading lines made up with dependable CHIKSAN ball-bearing swivel joints provide a wide margin of safety by using the same materials used throughout the pipe lines.

Any required degree of flexibility is provided, simply by arranging CHIKSAN ball-bearing swivel joints in proper sequence. Total length of any arm is governed by the required length of pipe sections between swivels. Whether it be a standard design loading arm or a special design for a specific problem, write CHIKSAN today, the nature of your requirements.

Write to Dept. 128 for Catalog giving complete detailed information.



The four loading arms illustrated are standard CHIKSAN designs and can be ordered as a package. These loading arms are also available for the handling of chemicals and steam.

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Now you can give your products protection against contamination and discoloration during processing, storage and transportation . . . and at a surprisingly low cost! It's possible through the use of CF&I LECTRO-CLAD Nickel Plated Steel, electroplated by the patented Bart Process.

For over ten years, the Atomic Energy Commission and leading chemical processing firms have used pipe and fittings nickel-electroplated by the Bart Manufacturing Corporation process. Now, by combining Bart's experience in this field with CF&I's wide range of research facilities, this process has been extended to produce CF&I LECTRO-CLAD plate and sheet as well as pipe and fittings.

These steel products have all the strength of regular carbon steel; in addition, they're coated with a uniform, heavy layer of metallic nickel that's over 99% pure. This gives much better protection against product contamination and discoloration than bare carbon steel or steel protected with various coatings.

What's more, CF&I LECTRO-CLAD Nickel Plated Steel can be shaped and fabricated by all of the usual methods without damage to its nickel coating. Bend it . . . weld it . . . roll it . . . the protective nickel layer will not check, spall or flake!

Perhaps you can use CF&I LECTRO-CLAD Nickel Plated Steel to excellent advantage in your product handling, transportation and storage operations. For full details, contact the nearest district sales office listed below.

Claymont Steel Products

Products of Wickwire Spencer Steel Division · The Colorado Fuel and Iron Corporation
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CF&I

2942

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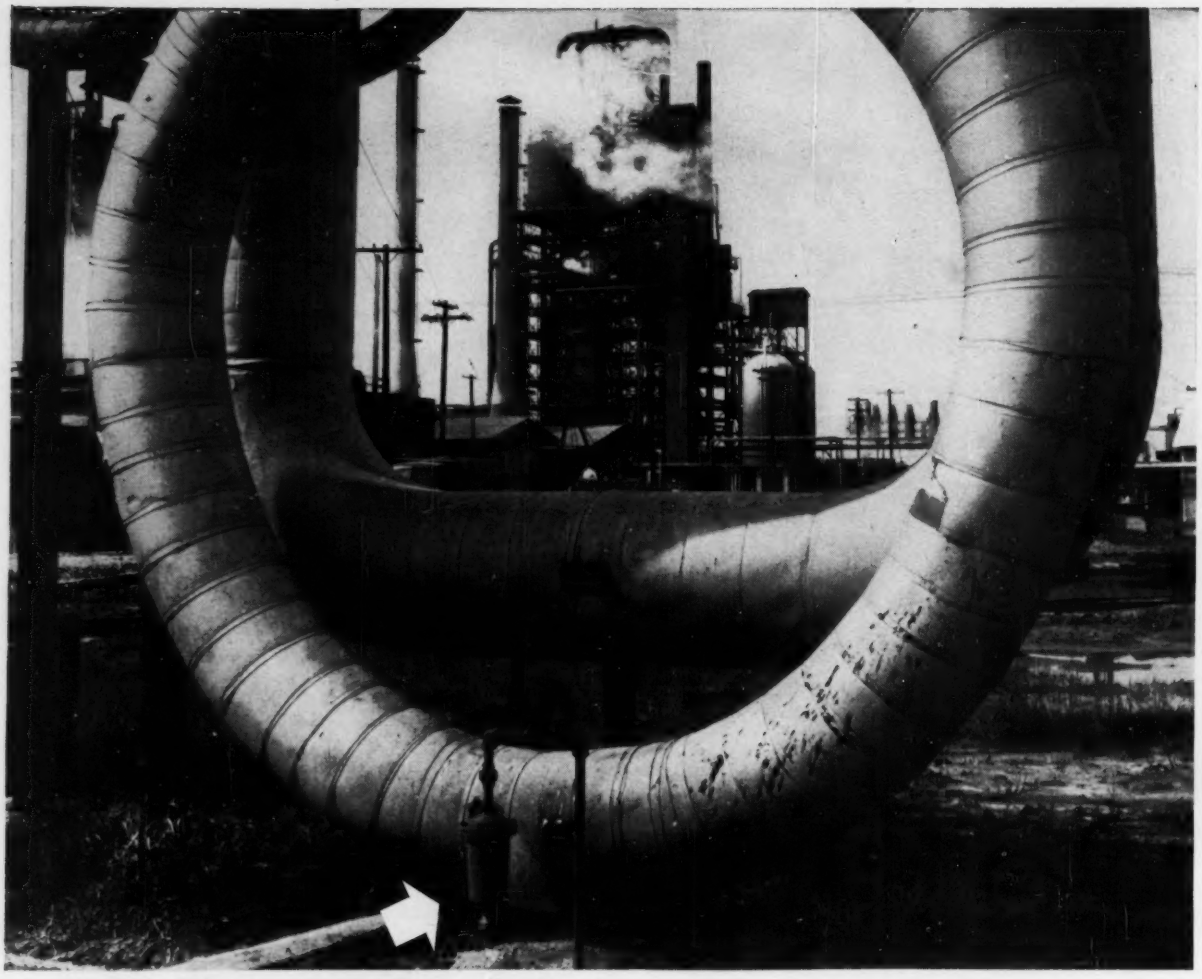

Look Ahead When You Specify Steam Traps...

100 or 1,000 or 10,000 steam traps in a plant are a small item in relation to the processing equipment that depends upon them. But if they are troublesome, headaches are just multiplied by the number in use. It hardly pays, then, to be pennywise in specifying traps.

Perhaps the biggest single consideration in choice of traps should be their long-range performance. Look ahead—will the traps do the job? Will they stand up? Will they require frequent maintenance?

No traps in the world have ever turned in better performance records than Armstrongs. And, here is why:

Design—simple... only two moving parts . . . "frictionless" free-floating leverage... heavily reinforced for wear . . . generous safety margins.

Materials—file-hard chrome steel valve and seat, hardened, ground and lapped together. All other parts corrosion-resistant stainless.

Experience—designed and built by men with more inverted bucket trap experience than any other organization.

Inspection—quality control is not by sampling—*every trap* is tested before shipment.

Guarantee—satisfaction or your money back.

When you specify Armstrong traps you can look ahead to long, long trap life with infrequent maintenance. Ask your Armstrong Representative to give you details or write:

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858 Maple Street, Three Rivers, Michigan

Application Engineered
ARMSTRONG STEAM TRAPS

ASK FOR STEAM TRAP BOOK

... 44 pages of practical data designed to give you better trapping. Free on request . . . no obligation.

S75

PROVED PERFORMER

This mass of rubber and steel is a fine example of early automotive design, and is still in running condition today, almost half a century after it was built. It is an antique Cadillac touring car de luxe of the duster and goggles era.

Esso Petroleum Solvents have had the same test of time, and like the Cadillac, have built a fine reputation for superior quality and unfailing dependability. Why not get the highest quality next time you order? Specify Esso Petroleum Solvents for the quality your product deserves.

You can depend on Esso Solvents for

MULTI-STORAGE AVAILABILITY—water terminals in industrial centers.

MODERN HANDLING METHODS — separate tank storage, pumping lines, tank cars and trucks are used in all handling operations. Prompt delivery to your door is assured.

SOLVENCY — Esso aliphatics and Solvesso aromatics cover both high and low solvency ranges.

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FOR TECHNICAL ASSISTANCE — If you have a solvents problem or want further information on the specifications and characteristics of Esso Solvents—write or call our office nearest you. Our technicians will be glad to assist you.

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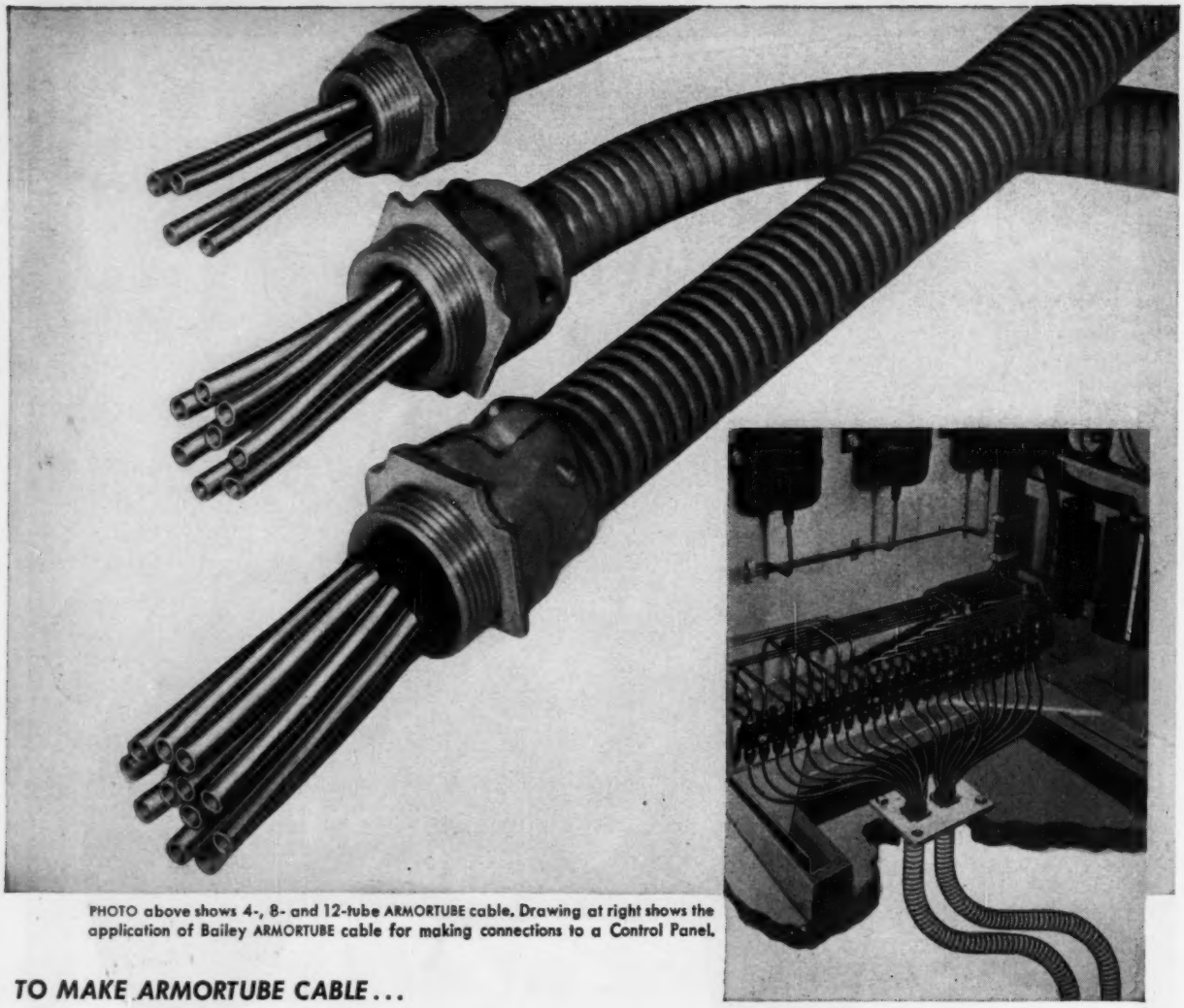

PHOTO above shows 4-, 8- and 12-tube ARMORTUBE cable. Drawing at right shows the application of Bailey ARMORTUBE cable for making connections to a Control Panel.

TO MAKE ARMORTUBE CABLE . . .

Bailey Meter Company turns to Anaconda for long lengths of ¼" O. D. copper tubes

Bailey Meter Co., Cleveland, Ohio, calls its ARMORTUBE Flexible Protected Tube Cable, "the modern shortcut to simpler, safer, more economical air and hydraulic circuits."

As shown above, this cable is available in bundles of four, eight or twelve ¼" O.D. copper tubes. A continuous, heavy galvanized steel strip protects the tube bundle.

Here's why Bailey turned to Anaconda as the logical source of supply for these ¼" O.D. copper tubes.

LONG LENGTHS

Because ARMORTUBE cable is shipped in random lengths of about 500 feet, Bailey needed long lengths of copper tube. Anaconda makes copper tube up to 2,400 feet long, depending on the diameter.

CLEAN INTERIORS

These tubes had to be free from dust, dirt or metal chips which might otherwise interfere with the operation of delicate air and hydraulic circuits. Anaconda takes special care to see that inside surfaces of ANACONDA Copper Tubes are clean, smooth and bright. Tube ends are sealed to keep out moisture and foreign matter during storage.

FLEXIBLE

Tubes had to be flexible enough to bend around corners and obstacles. ANACONDA Copper Tubes are uniformly soft . . . highly flexible. And they are accurate in size and shape.

ANACONDA Dehydrated Copper Tubes are made in all standard sizes up to and including ⅞" O.D. Usually furnished in 25-, 50- and 100-foot coils, they are also available in longer lengths on spools and reels where required.

Our Technical Department will be happy to lend a hand on any problem involving the use of copper tubes. A letter outlining your problem will bring a prompt answer. Write to: The American Brass Company, Waterbury 20, Conn. In Canada: Anaconda American Brass Ltd., New Toronto, Ont.

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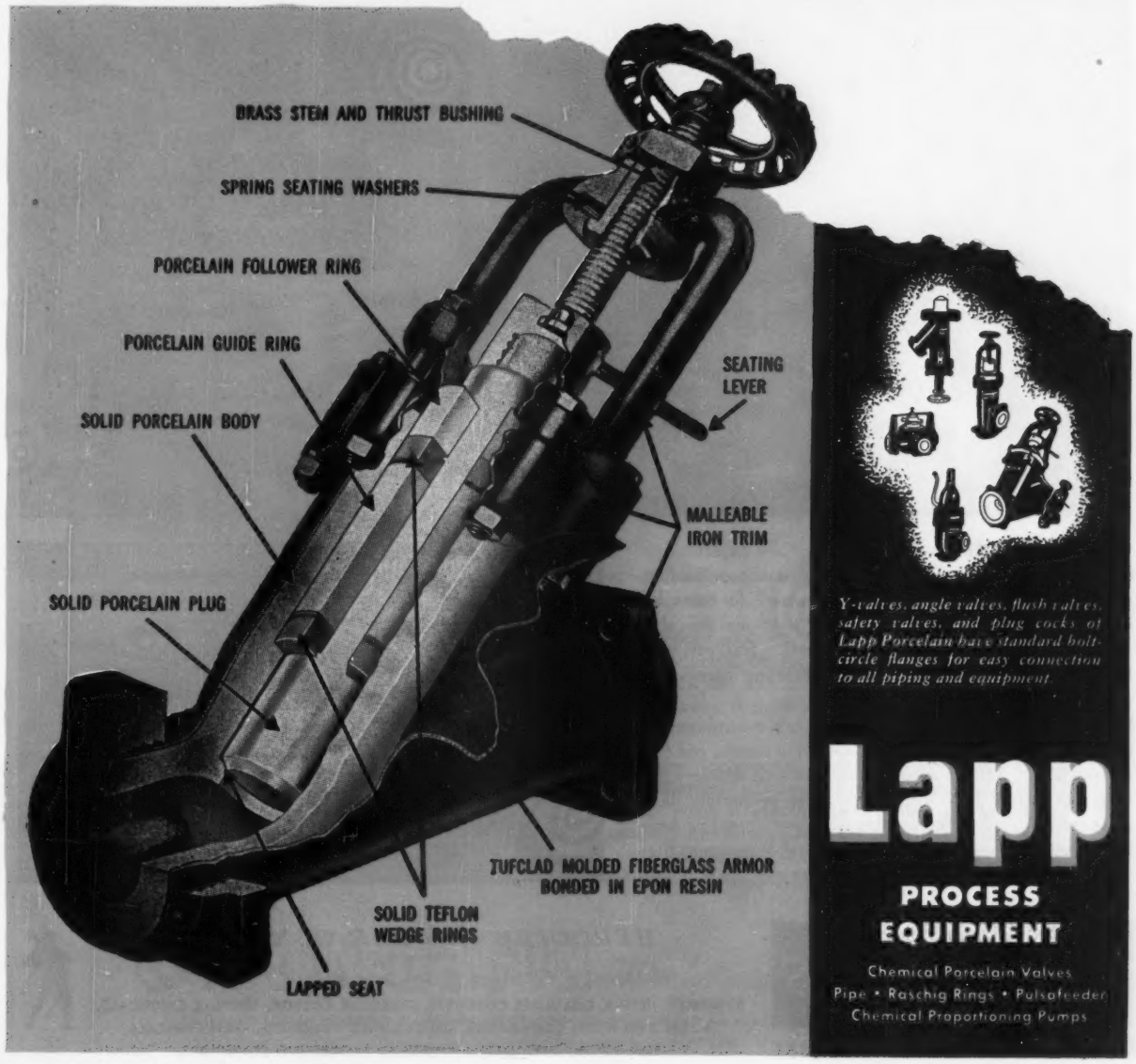
Precision Grinding of Solid Porcelain in the Lapp Valve

The high firing temperature, which assures complete vitrification and zero porosity of Lapp Porcelain, also makes impossible the maintaining of close dimensional tolerances. Necessary tolerances are achieved, however—in regular production ±.001″—by machine grinding with silicon carbide wheels. In the Lapp Valve, the entire stuffing box chamber, seating area, plug, guide and follower rings are finish ground, for precision assembly and complete interchangeability of parts. In addition, each porcelain plug is individually lapped and polished into its seat integral in the valve body. (No separable seating parts.) Each such valve seal is tested to 150 psi hydrostatic pressure before the valve is shipped.

Write for bulletin with complete description, characteristics, and specifications. Lapp Insulator Co., Inc., Process Equipment Division, 417 Wendell St., LeRoy, New York.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SEATING LEVER
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Y-valves, angle valves, flush valves, safety valves, and plug cocks of Lapp Porcelain have standard bolt-circle flanges for easy connection to all piping and equipment.
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Pipe • Raschig Rings • Pulsafeeder
Chemical Proportioning Pumps

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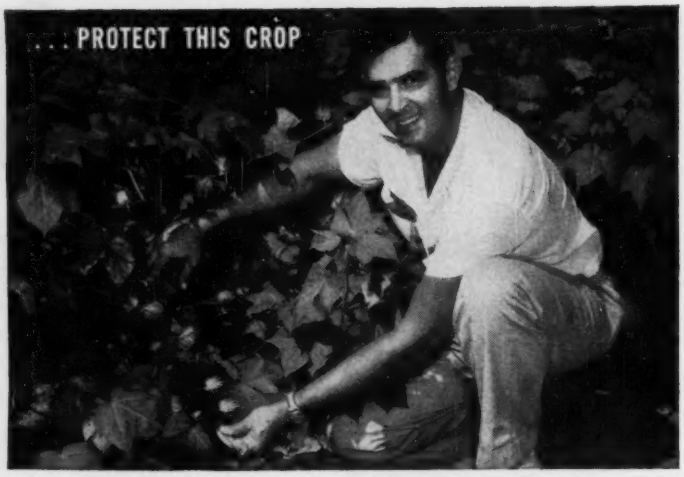
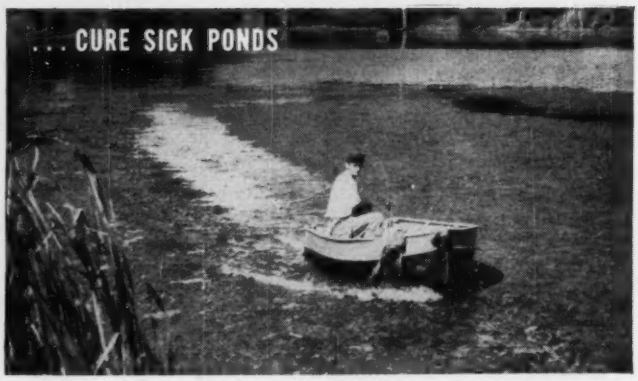


TARGET FOR INSECT PESTS—Tender cotton bolls, a delicacy for insect pests, are safeguarded by toxaphene insecticides. Dusts and sprays, based on Hercules toxaphene, are now used all over the world and recommended for the control of more than 200 species of destructive insects.

VERSATILE PAPER—A number of Hercules papermaking chemicals go into the paper cups, plates and napkins that add to outdoor enjoyment. Hercules Kymene®, for example, imparts wet strength to paper products. Additional desirable characteristics are obtained with Pexol® fortified size, Paracol® wax emulsion, or other Hercules sizing ingredients.

NEW ALGICIDE, Hercules Delrad®, effectively controls pestiferous algae in farm ponds, lakes, irrigation canals, and fish rearing ponds. Easy to apply, Delrad not only destroys the algae but causes it to disintegrate, thus preventing dead algae from producing undesirable odors and imparting taste to the water. (Photo courtesy Agricultural Experiment Station, Alabama Polytechnic Institute.)



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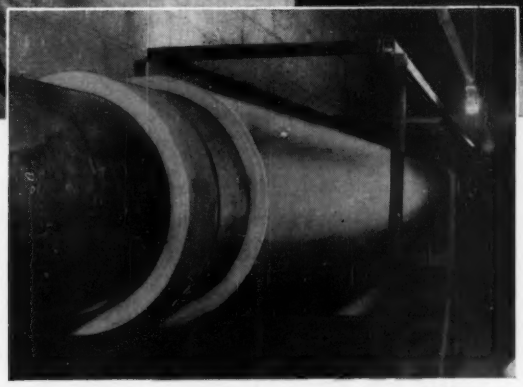

SNAP*ON...

the modern, efficient way to insulate pipe

Take a good look at the unique one-piece glass fiber pipe insulation that insulates a 6-foot section of pipe as quick as you can say "Snap*On!" Then picture the savings in your plant when you put Snap*On on large or small, hot or chilled piping.

These on-the-job photos were taken at a midwestern university where large steam distribution lines in tunnels were recently insulated with Snap*On. The job was done in remarkably short time because of the exceptional ease of application. Workmen were pleased to discover that Snap*On weighed only 1/10 to 1/4 as much as conventional insulations — yet was so fibrous-tough that there was no breakage . . . no mess . . . no clean-up time.

An important secondary saving was the heat saving. Tests conducted on the finished job by the university showed the surface temperature of Snap*On to be 50° lower than that recorded on the insulation formerly used!

These are documented facts. The same sort of superior thermal efficiency and low-cost application can be yours if you insulate piping up to 33" in diameter, where temperatures do not exceed 350°. But see for yourself — write today for samples and Technical Bulletin SO-55 today.

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Lagging Public Construction — A Spreading National Blight

The most recent editorial in this series dealt with the plans of American industry for expanding and modernizing its plant and equipment over the next four years. These plans call for the expenditure of $113 billion over that period. There is a good prospect that the money to carry them out will be available. If the plans are carried out, manufacturing capacity at the end of 1958 will be double that which existed at the end of World War II. And this industrial plant will be modernized.

In sharp contrast to this picture is the condition of our *public* plant and equipment — the roads, schools, water supply, health and sanitation facilities upon which industry, as well as the average family, depends. **According to a recent estimate by the Twentieth Century Fund, the people of the United States must spend almost $100 billion on new public works projects during the next five years merely to meet the minimum needs of our growing economy.**

Other estimates by the President's Council of Economic Advisers, by state agencies and by private construction economists all show the same condition: a staggering need for public works. Yet no steps have been taken that even offer a promise of closing the gap between the public facilities we are building and the greater facilities we really need.

How did we come to let our public facilities fall into this sorry state? Here are some of the reasons:

(1) During the years of depression and war, from 1930 to 1945, these facilities were neglected. New construction declined, and even maintenance was cut.

(2) Since the end of World War II, increased construction costs have made it difficult for communities to get the needed construction with the funds budgeted in the past for that purpose.

(3) The great postwar upsurge in population, and the spreading of our population into new areas, has created a huge demand for additional community facilities before the neglect of earlier years could be made up.

Responsibility Divided

Now the need for more public construction has become apparent to everyone, on jammed highways and in over-crowded schools. But, unfortunately, the responsibility for doing something about this situation cannot be so clearly fixed as can the responsibility for maintaining industrial facilities. A business firm must expand its capacity when markets are growing or lose its trade position. It must modernize its plant and equipment or be undersold by more efficient competitors. In the case of public facil-

ities, there is no such competitive incentive. To be sure, a city or state may lose population and industries if its public facilities are inadequate. But such shifts are very slow to take place and difficult to relate to any specific public program, or lack of it.

Moreover, the responsibility for constructing public facilities is divided between state and local governments and federal authorities. Within each of these governmental units there are specialized bureaus or departments with varying responsibilities. This division of responsibility obviously adds an element of difficulty to the development of an adequate program of public construction.

Breaking the Log-Jam

How can this administrative log-jam be broken and the financial difficulties overcome?

One course would be to have the federal government step in with a nation-wide new program of direct spending on public works. That would utilize the resources of the federal treasury for immediate action. But there are weighty objections to such extensive federal participation. One is that federal spending cannot be greatly enlarged without a corresponding increase in the federal control of decisions that normally have been left to local communities. Another objection is based on the fact that so long as we must maintain a large defense establishment, such an addition to federal spending means either higher taxes or a chronically unbalanced budget.

The other course is to rely primarily on local initiative, but with new and more effective federal aid to local governments. Such aid would help speed up planning and construction, and contribute toward a solution of the most burdensome financing problems, but in amounts sufficiently limited to require that most of the capital be raised locally.

No Single Formula

No one formula can be applied to make such aid effective. The raising of funds for new schools, for example, involves problems very different from those of financing highways, or water-works, or hospitals. But it does seem clear that, in all these fields, the federal grants must be designed to stimulate more local planning and financing than has prevailed in the past. Among the new ideas that may offer such incentives are federal grants for planning and initial costs and federal guarantees of local bond issues. Such aids have been remarkably effective in the fields of slum clearance and public housing.

While the federal government clearly has a role to play, we cannot afford to postpone inauguration of an adequate public construction program while we seek a formula to apportion governmental participation that would be generally accepted as ideal. Every year about 2½ million more Americans are putting increasing pressure on a public plant already dilapidated and inadequate. The result is an increasing menace to comfort, health, education and safety. It is also an increasing menace to the effective performance of American industry.

The appropriate public response to this situation is a driving public determination to eliminate this increasingly dangerous lag in public construction. At this juncture, the development of such a determination is basic. Nothing stands in the way of an adequate program of public construction that a determined electorate cannot remove.

This message is one of a series prepared by the McGraw-Hill Department of Economics to help increase public knowledge and understanding of important nationwide developments that are of particular concern to the business and professional community served by our industrial and technical publications.

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Donald C. McGraw

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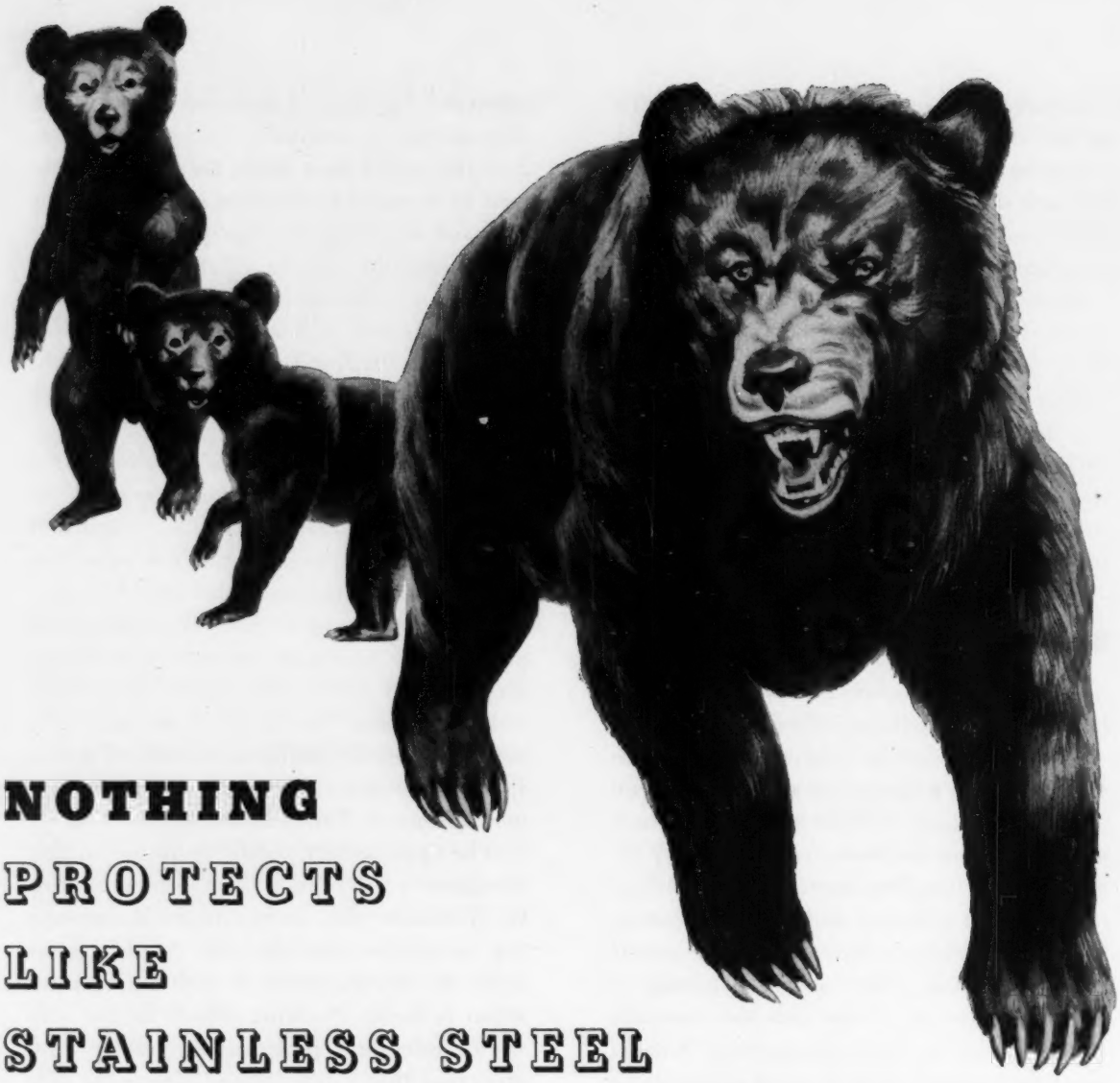
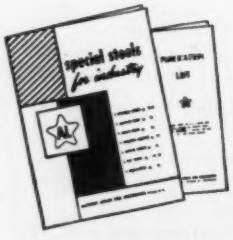


NOTHING PROTECTS LIKE STAINLESS STEEL



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Many materials are good-looking. Some are strong. Some resist corrosion. But not one other commercially-available material offers the same combination of beauty, high strength, high hardness and resistance to corrosion, heat and wear that stainless steel can give you. Not one has the ability to protect as completely, last as long and cost you as little in the long run.

These qualities in AL Stainless Steel can boost the salespower of a product, or cut the operating costs of equipment—often with little or no increase in first cost. Very likely *you* have problems where these advantages can bring you benefits. Let us work with you. ***Allegheny Ludlum Steel Corporation, Oliver Bldg., Pittsburgh 22, Pennsylvania.***

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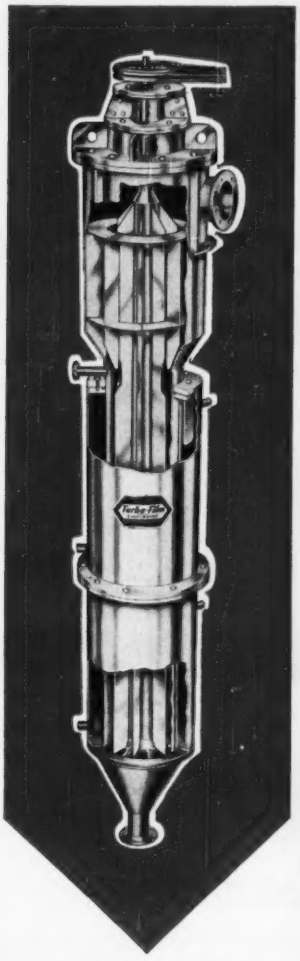

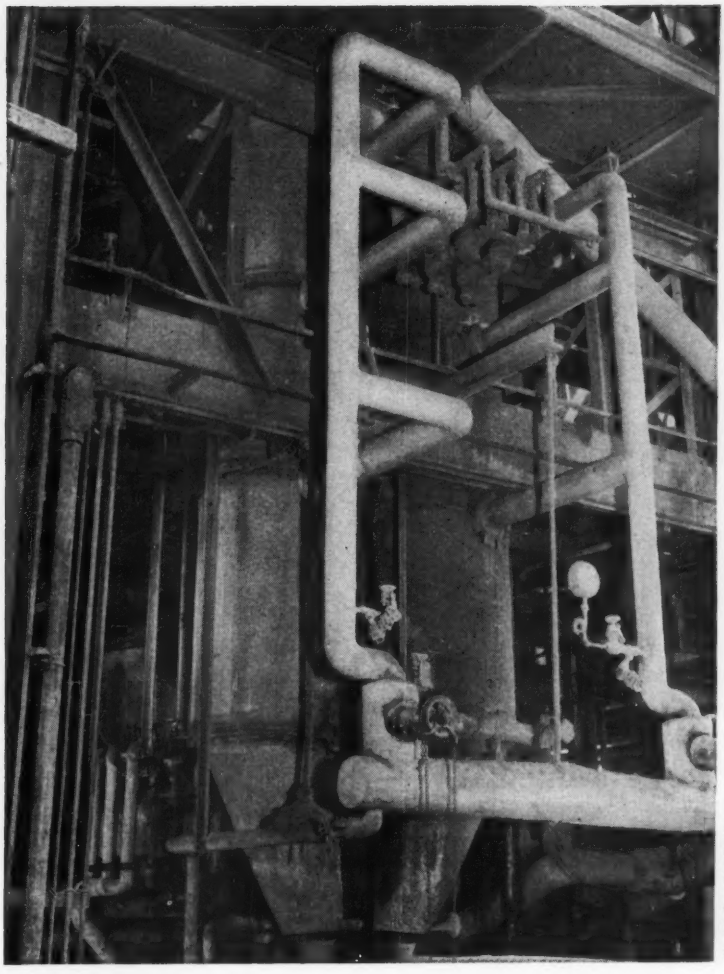

At left—two of four No. 5 Turba-Film Evaporators at Allied Chemical & Dye's South Point, Ohio, works.

Abrasive fertilizer slurry is rough test of TURBA-FILM® EVAPORATORS

Four Rodney Hunt No. 5 Turba-Film Evaporators working under the most difficult conditions are used in the production of Arcadian 12-12-12, a new and highly efficient chemical fertilizer manufactured by Allied Chemical & Dye Corporation.

The fertilizer is made at Allied's South Point, Ohio, plant. The various chemical ingredients are mixed to form a slurry which must then be reduced to uniform granules of low moisture content. Turba-Film evaporators were found capable of reducing moisture content from approximately 20% to 6% at high production rates.

Although the evaporation takes place at high temperature and under exceedingly abrasive conditions, the four Turba-Film Evaporators handle the entire capacity of the company's production line.

If you have a problem of moisture or solvent removal from liquids, pastes, or slurries, write to Rodney Hunt for information on the efficient Turba-Film Evaporator and the Rodney Hunt-Luwa Spray Dryer.

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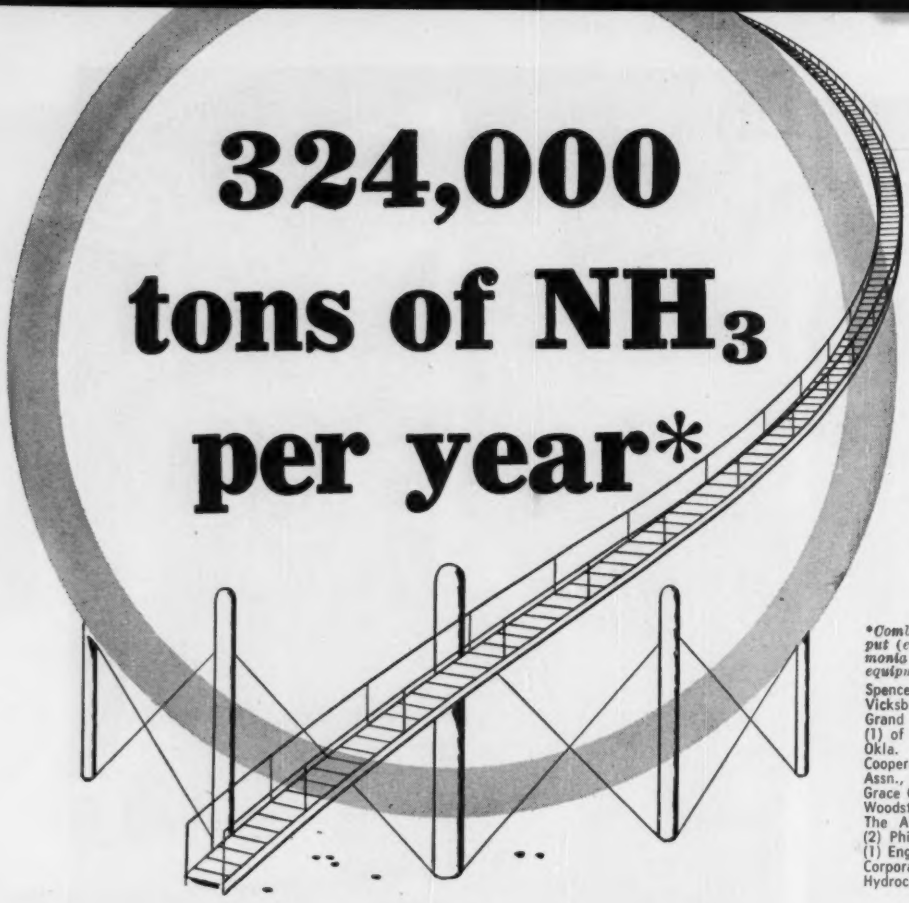
MANUFACTURING ENGINEERS SINCE 1840

324,000 tons of NH_3 per year*



*Combined yearly capacity output (est.) of following five ammonia plants using TRANE equipment:

Spencer Chemical Company (1) Vicksburg, Miss.
Grand River Chemical Division (1) of Deere & Company, Pryor, Okla.
Cooperative Farm Chemicals (1) Assn., Lawrence, Kan.
Grace Chemical Company (1) Woodstock, Tenn.
The Atlantic Refining Company (2) Philadelphia, Pa.
(1) Engineered by Foster Wheeler Corporation. (2) Engineered by Hydrocarbon Research, Inc.

. . . *in plants using Trane Heat Exchangers*

Higher outputs at lower temperatures! At -300° F. Trane Brazed Aluminum Heat Exchangers are performing with superior efficiency, economy . . . dependability!

THE FIVE MODERN AMMONIA PLANTS listed above—estimated total NH_3 capacity 324,000 tons per year!—are but a few of the many modern plants using TRANE Brazed Aluminum Heat Exchangers for low temperature applications.

LOWER OPERATING COSTS, plus the ability to perform efficiently and economically at temperatures as low as -350 degrees F. explain why TRANE Brazed Aluminum units are used in so many new, modern air separation and ammonia plants. Even when *large* heat transfer duties are involved, they can obtain temperature approaches of 5 degrees F. or closer. Operating costs go *down* . . . because *less* refrigeration is required to bring a specified liquid or gas to desired temperature!

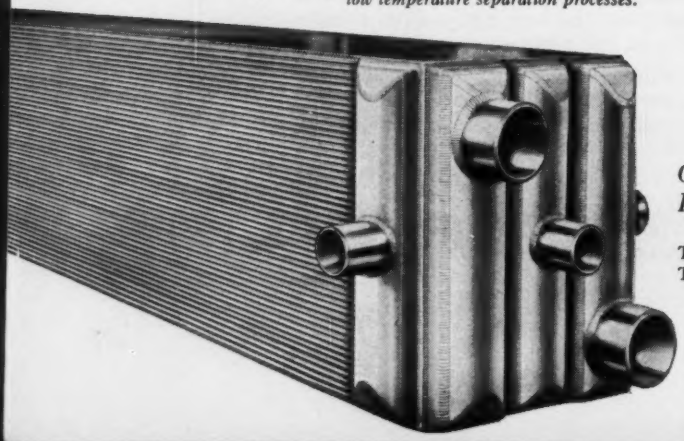
LOWER INITIAL COSTS—lower installation costs, too—are among the reasons for the steadily increasing use of TRANE Brazed Aluminum Heat Exchangers.

These compact, light-weight units pack up to 450 square feet of heat transfer surface into a single cubic foot. Units are now available for operating pressures *up to 600 psig!*

If you have a heat transfer problem involving *low temperatures, multi-stream exchange* or *close approaches,* it's time to call TRANE.

OUR 30 YEARS' EXPERIENCE in all phases of heat transfer is at your disposal. Just contact your nearest TRANE Sales Office or write on company letterhead to TRANE, La Crosse, Wisconsin.

TRANE *Brazed Aluminum Heat Exchanger of the type used for air separation, ammonia, and other low temperature separation processes.*



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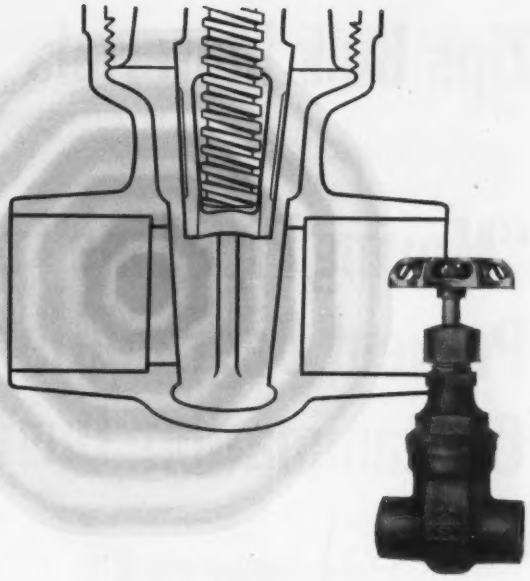
When the heat's on

you need the extra strength of

JENKINS

Solder and Socket End

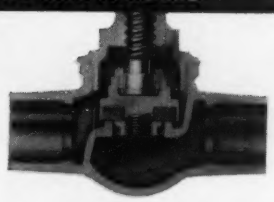
VALVES



Solder End GLOBES and ANGLES

300 lbs. O.W.G.
¼" to 3"

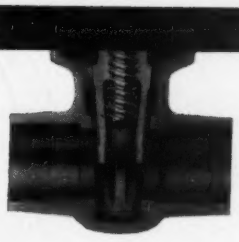
Fitted with Renewable Composition Disc.



Solder End GATES

225 lb. and 300 lb. O.W.G.
⅜" to 3"

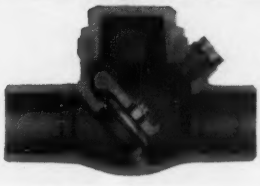
With solid or split wedges, and stationary or traveling spindles.



Solder End CHECKS

300 lbs. O.W.G.
¼" to 3"

Regrinding. May be easily reground without removal from line.



NEW BULLETIN Lists all Jenkins Solder End and Socket End Valves and gives complete instructions for soldering and brazing. Ask for Solder-Socket End booklet.

The "light-duty" look of copper tubing installations is deceiving. Valves must provide an accurate fit to tubing and *hold it* under the intense heat of soldering. And, because flexible tubing does not afford the rigid support of standard pipe, valves must withstand unusual strains in operation.

Jenkins Solder End Valves are engineered to meet these demands with strength to spare. High tensile bronze castings have liberal dimensions for extra rigidity. Smooth, clean bores assure accurate fit, easy soldering, positive seal to types K, L, and M Copper Tubing.

For faster, trouble-free installation, and lasting economy, specify Jenkins Solder End Valves. Jenkins Bros., 100 Park Ave., New York 17.

JENKINS Socket End Valves

for Class B or IPS Tubing

Jenkins bronze valves with socket ends for silver-brazing are made in Globe, Gate, and Swing Check patterns to control compressed air, hot oil, and similar fluids in tubing hookups where specifications call for permanent, leakproof joints. Complete information in the Bulletin offered below.

JENKINS
LOOK FOR THE JENKINS DIAMOND
VALVES
SINCE 1864 TRADE JENKINS MARK
Jenkins Bros.

SOLD THROUGH LEADING INDUSTRIAL DISTRIBUTORS

Zips Bulk Materials Into a "Moving Pipe Line" to Prevent Degradation, Contamination, Dust

S-A "ZIPPER" CONVEYOR-ELEVATORS

for sealed handling of BULK FOOD, CHEMICALS, GRAIN

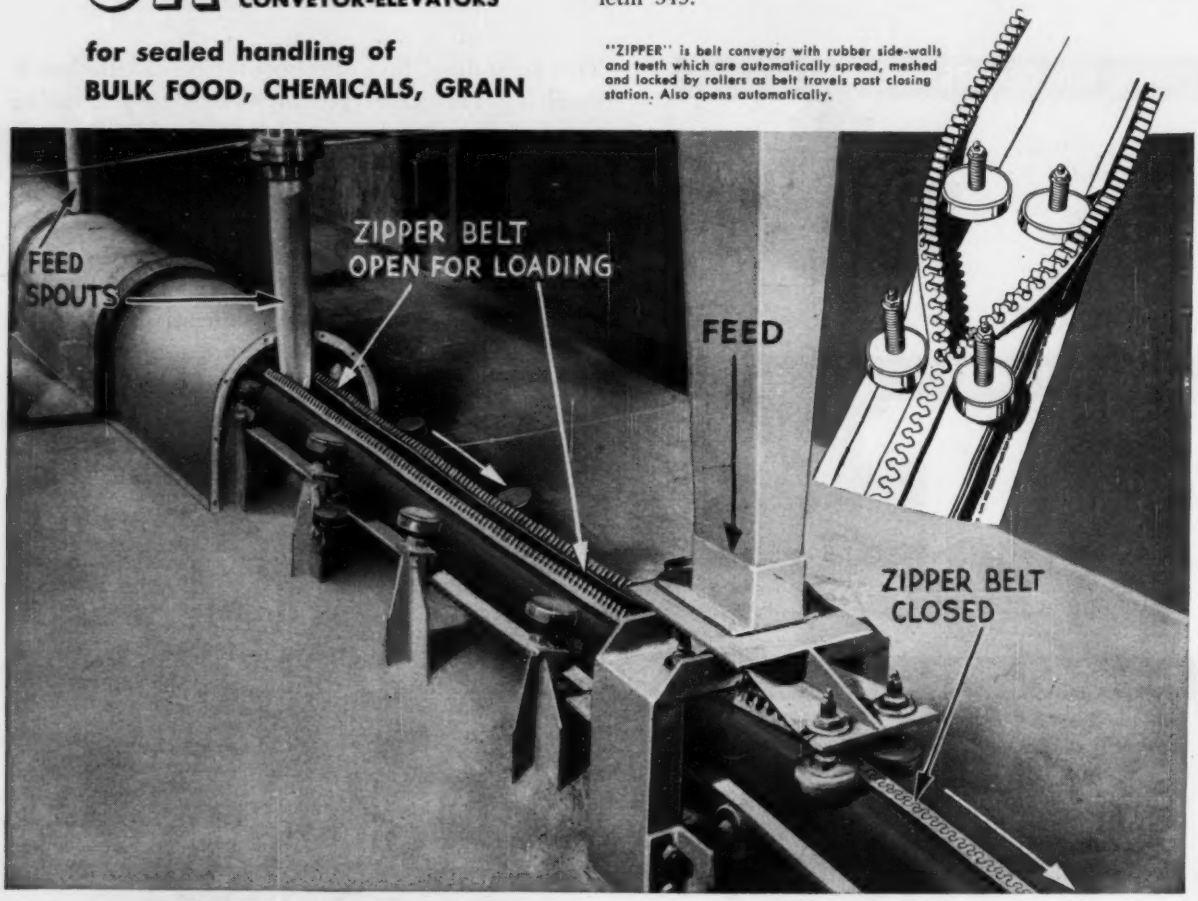
THE S-A "ZIPPER" Conveyor-Elevator seals bulk materials into a rubber "tube" that moves with the load. Conveys up, down or horizontally — in one or more planes — without crushing or packing granular, flaky, pulverized or lumpy materials. There's no agitation, no segregation, no abrasion against conveyor sides, no pressure exerted on the material to move it. The load is fully enclosed — there's no chance for spillage — dust is sealed in, contamination sealed out.

Complete Discharge

"ZIPPER" belt opens for loading and discharge. There are no pockets in which material can collect. "ZIPPERS" are equally suitable for long or short distance conveying and elevating in minimum space and with simple support. Power requirements are usually less than for conventional conveyors handling similar loads.

For more facts and typical arrangements, write for Bulletin 349.

"ZIPPER" is belt conveyor with rubber side-walls and teeth which are automatically spread, meshed and locked by rollers as belt travels past closing station. Also opens automatically.



STEPHENS-ADAMSON MFG. CO.

3 Ridgeway Avenue, Aurora, Illinois • Los Angeles, Calif. • Belleville, Ontario

Engineering Division
Specialists in the design and manufacture of all types of bulk materials conveying systems.

Standard Products Division
A complete line of conveyor accessories including centrifugal loaders—car pullers—bin level controls—etc.

Sealmaster Division
A complete line of industrial ball bearing units available in both standard and special housings.

No. 3F (60 cu. ft. capacity) Mix-Muller equipped for continuous charge by 2 batch hoppers. Mill conveyor handles discharge.

make continuous quality a part of continuous processing

Make continuous mixing practical with these Mix-Muller features:

- *Complete dust enclosure of pan to enclose: volumetric or weigh type batch hoppers.*
- *Time Master® control for automatic batching, charging, addition of liquids, discharge and recycle.*
- *Double, automatic, bottom, discharge doors are available.*

Speed is profit these days, and it follows that the more continuous you can make your processing — the more continuous can be your profit . . . *sometimes!*

If you've had experience with continuous mixing you may have found that speed was gained *at a loss* in quality, at a high cost in equipment. That's why the Simpson Mix-Muller is designed to combine the distinct advantages of batch mixing with complete adaptability and flexibility for use in continuous processing.

Your National Engineer can help you profit from the experience of hundreds of successful blending operations . . . Installations where the Simpson Mix-Muller is assuring high quality, intimate mixing and effective arrangement of equipment insures continuous *positive* flow of materials to continuous operations such as extruding, briquetting, pressing, tabletting, drying, etc. Write today for details and remember:

Mixing is our business . . . our only business for over 40 years.

SIMPSON *MIX-MULLER*® DIVISION

NATIONAL ENGINEERING CO., 636 Machinery Hall Bldg., Chicago 6, Ill.
(Not Inc.)

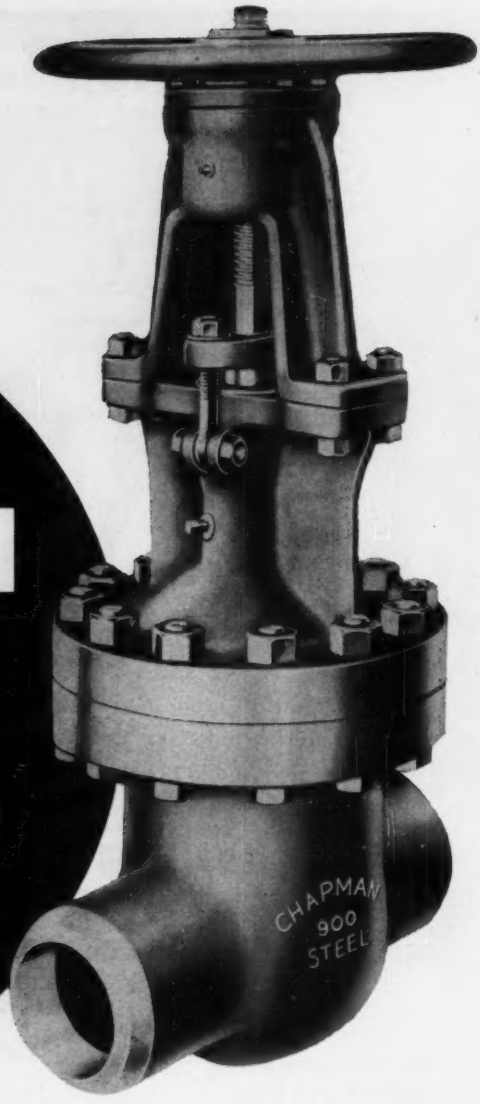
Specify

CHAPMAN STEEL VALVES

in any of the

Standard Alloys

to meet your steel valve needs



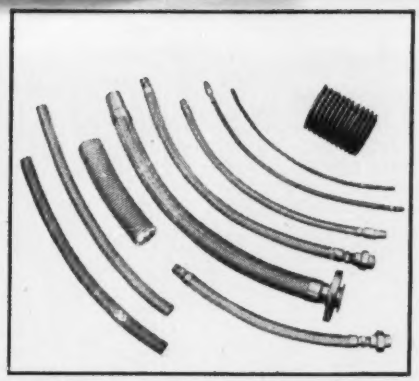
When you specify Chapman Steel Valves you also specify valve steels designed for your specific services. Standard alloys match every normal oil industry requirement. Special alloys can be furnished for extraordinary service conditions. All metals are poured in Chapman's own foundries under rigid laboratory supervision.

Exceptionally close machining tolerances are another standard feature of Chapman Steel Valves. Under the most severe conditions, Chapman Steel Valves seat tightly and positively, without jamming, chattering or wearing excessively. Operation remains smooth and dependable; maintenance costs stay low.

See Chapman *first* for gates, globes and checks in all pressure classes — 150, 300, 400, 600, 900 and 1500 pounds — and for temperatures from —150°F to 1200°F. Valves are available with bolted or welded body and bonnet joints and with flanged or welding ends. API standards are equalled or exceeded in every range. Write for Catalog No. 20.

THE CHAPMAN VALVE MANUFACTURING COMPANY

INDIAN ORCHARD, MASSACHUSETTS



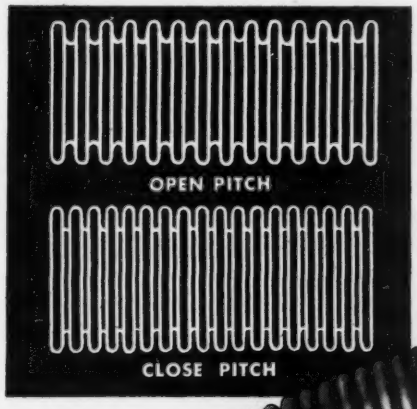
Typical American Stainless Steel Tubing and assemblies designed and manufactured for specific service conditions.

To convey high-temperature, high-pressure CORROSIVE gases and liquids...

AMERICAN'S

FLEXIBLE STAINLESS STEEL TUBING

stands up under continuous flexing
absorbs severe vibration
compensates for misalignment
is easily installed



American Flexible Stainless Steel Tubing. Cutaway section, right, shows annular construction.

American's Flexible Stainless Steel Tubing was developed to convey searching and corrosive liquids and gases under varying temperature and pressure conditions. It is available in Stainless Types 316 and 321 in sizes ¼" I.D. and up. Stainless steel wire braid covering gives added strength for high-pressure applications. American Flexible Metal Hose and Tubing is also available in bronze, aluminum, steel, monel, super-nickel, brass and other workable metals.

Complete assemblies include fittings attached by Heliarc welding or silver brazing. For help with *any* connector problem, talk it over with an American Metal Hose sales engineer. You'll save time and money when you take advantage of this specialized experience, and the design services offered by American.

56177

OPEN PITCH for general service

CLOSE PITCH for extra flexibility, frequent movement, excessive vibration

STAINLESS STEEL BRAID gives added strength for high-pressure service

ASSEMBLIES made up to your specifications complete with fittings attached

WHEREVER CONNECTORS MUST MOVE

AMERICAN FLEXIBLE METAL HOSE AND TUBING

AN **ANACONDA**® PRODUCT

FREE FOLDER!

Four-page folder gives engineering data on construction and types. Includes pressure ranges, bending diameters, weights, data on fittings.

Write *today* for your copy. ***Please print.***

CE

The American Brass Company, American Metal Hose Branch, Waterbury 20, Connnecticut.

Please send me a copy of Bulletin STC-1, "Flexible Stainless Steel Tubing by American."

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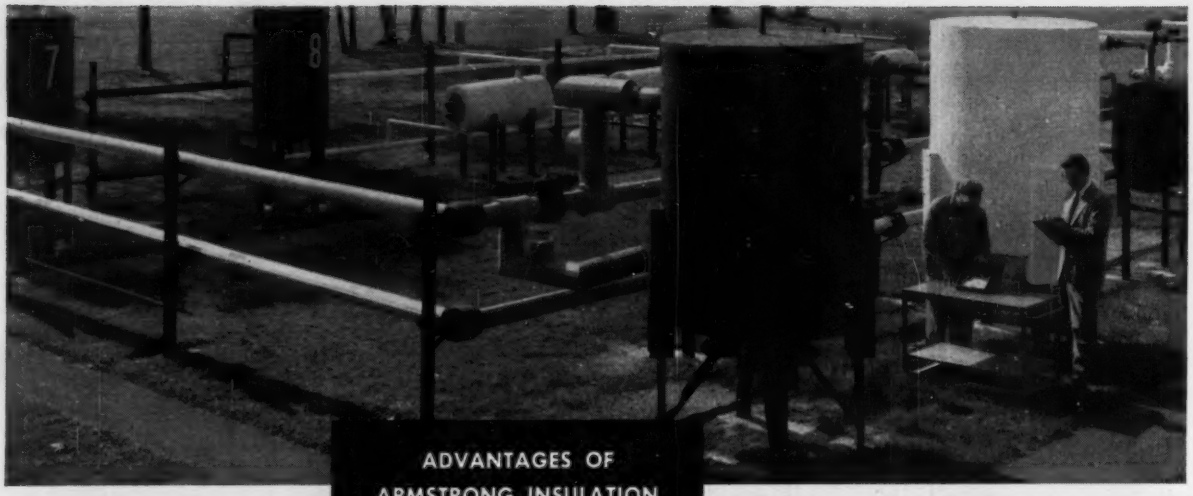
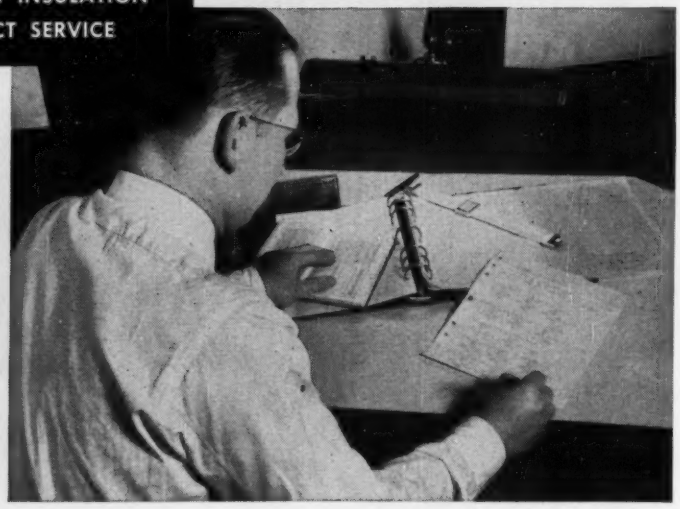


ADVANTAGES OF
ARMSTRONG INSULATION
CONTRACT SERVICE



ENGINEERING HELP . . . *backed by competent research to answer your insulation questions*

Whether you're faced with a tough insulation problem, or are simply developing a set of standard specifications, Armstrong sales engineers usually can offer you helpful suggestions.

Engineers from your local Armstrong office can work with your staff in planning efficient and economical insulation details for your job. If necessary, they can call on the facilities of the Armstrong Research and Development Center for additional help. Trained engineers and technicians from the Center are constantly working in the laboratory and the field to find ways of improving industrial insulation methods and materials.

The engineering help Armstrong can give you doesn't stop when the plans are drawn. Armstrong sales engineers stay with your job until the installation is completed, giving it their close, personal attention. A nation-wide network of 44 branch offices provides you with uniform job handling, no matter how far from your home office the installation may be.

Write for free booklet containing details on Armstrong Insulation Contract Service and the complete Armstrong line of high- and low-temperature insulation materials. Address Armstrong Cork Company, 2008 Sharpe Street, Lancaster, Pa. For immediate information, call the Armstrong office nearest you.

Armstrong INDUSTRIAL INSULATIONS

Armabestos* • Armaflex* • Armaglas* • Armatemp* • Corkboard • Cork Covering • Insulcolor®

*TRADE-MARK

WATSON-STILLMAN FORGED STEEL FITTINGS FOR: *Safe, Tight Connections* in pressure piping

■ In high pressure steam lines... process liquid and gas piping... hydraulic fluid lines... wherever strong, tough pipe joints are needed, Watson Stillman Forged Steel Fittings provide a safety factor against costly piping failures. They resist pressure, heat, corrosion, shock and vibration because they're drop-forged of high quality steel to produce a dense, tough, forged-fiber structure that can really take it.

Extra strength is built into W-S fittings in other ways too... such as the heavy reinforcing bands extending well beyond the threads or sockets.

Protect your high pressure piping system with Watson-Stillman Forged Steel Fittings. Available in carbon, stainless and alloy steels, in Screw-End and Socket-Welding Types to meet your service requirements. Send today for Free Catalogs.

Bulletin A3-50—Forged Steel Fittings
Bulletin S-1-55—Stainless and Alloy Fittings
Bulletin U-1—Forged Steel Unions
Bulletin S-3-55—150 lb. Stainless Fittings

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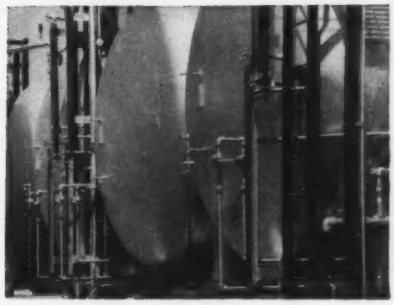
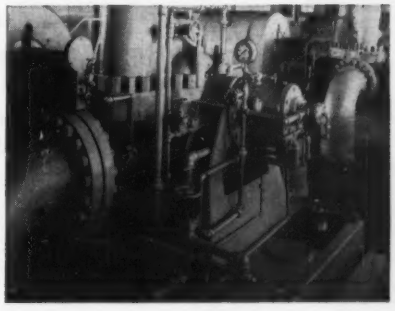


• *Process Liquid and Gas Piping*



• *High Pressure Lines*

WATSON-STILLMAN FITTINGS DIVISION
H. K. Porter Company, Inc.
Roselle, N. J.

IN QUALITY, DEPENDABILITY, AND LONG SERVICE LIFE . . .

. . . And WELDCO Tubular Products keep moving ahead as more and more buyers discover their many important advantages. WELDCO is produced by specialists — men who have the equipment, facilities and experience to manufacture pipe and tubing to your exact specifications. It's automatically machine-welded under pressure, properly formed, carefully finished, accurately sized and straightened, and rigidly checked. And remember, too, only WELDCO is welded with the exclusive Double-Fusion Process. . . . It's available in Stainless Steel, Monel, Inconel, Nickel, Cupro-Nickel, and Hastelloy, in tube and pipe sizes from 3" to 30", Schedules 5 and 10, and 3" to 12", Schedule 40. To get lightweight, corrosion-resistant Tubing with complete uniformity and long service life, always specify WELDCO — your best buy in top-quality tubing.

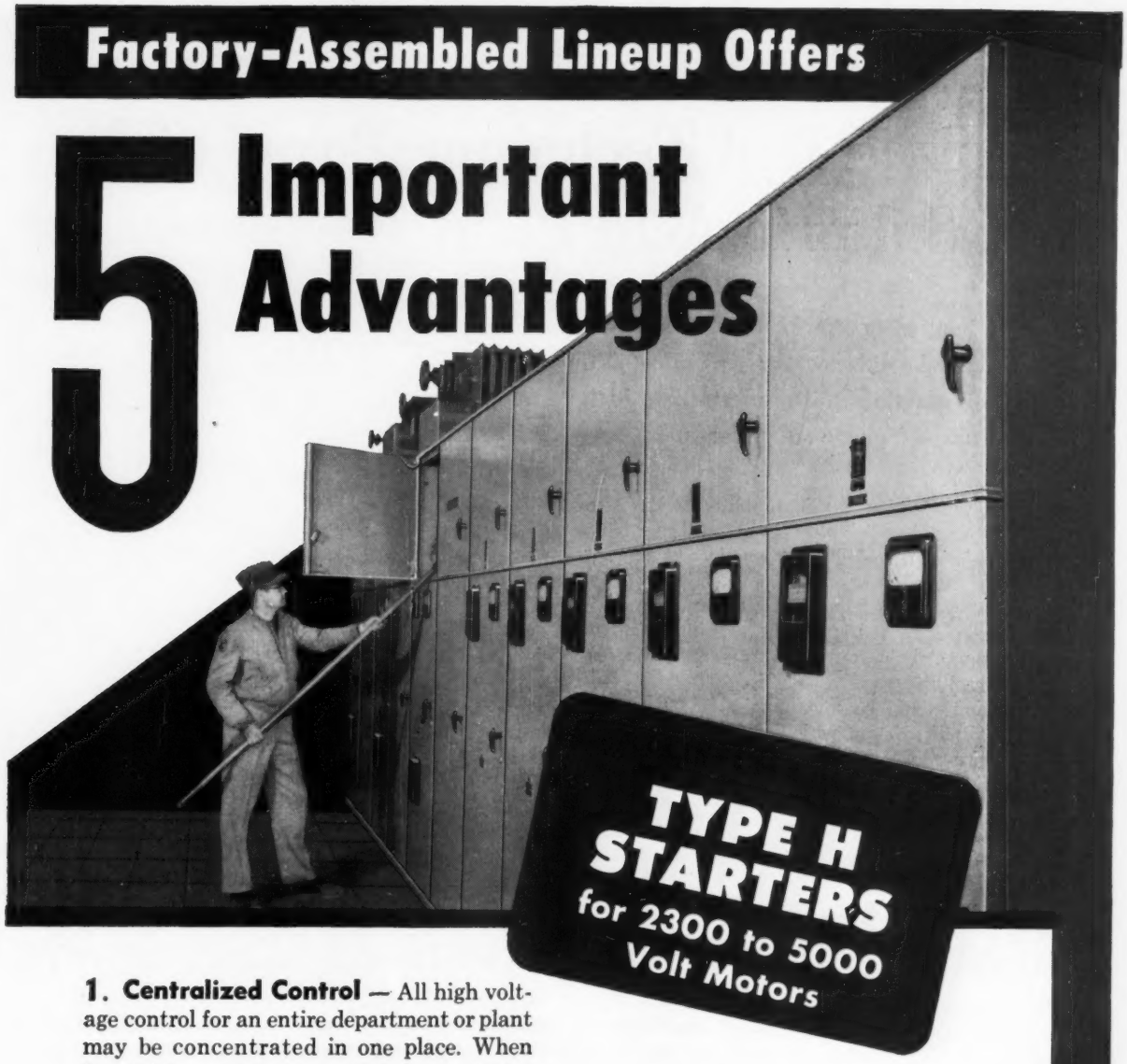
WELDCO

Whatever Your Needs In Tubing . . .
You're 'Way Ahead With WELDCO

THE YOUNGSTOWN WELDING & ENGINEERING CO.
3728 OAKWOOD AVE. . . YOUNGSTOWN 9, OHIO

Factory-Assembled Lineup Offers

5 Important Advantages



1. Centralized Control — All high voltage control for an entire department or plant may be concentrated in one place. When located in a separate control room, starter lineup operates in cleaner atmospheres. It also may be made inaccessible to unauthorized personnel.

2. Low-Cost Installation — Control group is factory-assembled *and bussed*. Conduit layout is greatly simplified. For example, lineup requires only one incoming power feeder.

3. Simplified Expansion — Internal bus and convenient wiring provision plus standardization of cubicle size facilitate addition of starters. Each starter unit is self-contained. Expanding the lineup is merely a matter of adding a starter and connecting the bus.

4. Attractive Appearance — Uniformity of cubicles presents a modern, streamlined appearance.

5. One-Company Responsibility Complete responsibility for assembling proper control devices and for control performance rests with Allis-Chalmers. A-4704

For complete information, see your A-C representative or write Allis-Chalmers, Milwaukee 1, Wisconsin.

ALLIS-CHALMERS

Fluidized Bed Technique Pays Off In New Sulfuric Acid Plant

Featuring the successful adaption of a fluidized solids reactor to a noncatalytic oxidation reaction, this modern plant is the first to use low-grade sulfur ores.

HAVE you considered using fluidized solids reactors in your chemical processes?

Anaconda is successfully using one in a new 450-ton-per-day contact sulfuric acid plant at Yerington, Nev.—part of a copper oxide leaching operation.

Here a fluidized bed is applied to an important unit process—noncatalytic oxidation—to produce SO_2 from low-grade sulfur ores.

Oxidation would be uneconomical in conventional roasters. But oxidation with fluidized solids provides the effective solids-gas contact, temperature control and fast reaction rates necessary for economical operation.

▶**How Fluidized Roaster Works**—Raw ore* is roasted in four cylindrical Dorrco FluoSolids reactors (25-ft. high, 18-ft. I.D.). These reactors are insulated with a 4½-in. wide innermost layer of fire brick, and with a 9-in. layer of insulating brick. The shell is welded steel. Each reactor roasts about 200 tons of ore per day, and one reactor is always held in reserve.

The ore, after a crushing operation in rod mills, feeds through an opening at the top of each reactor.

Fluidizing air is distributed through a horizontal, perforated plate fitted with a number of stainless steel nozzles. A feed rate of 9 tons per hr. of ore per reactor requires 8,000 cfm. of air at 3 psi. This is 75% excess air of that necessary to convert sulfur to SO_2.

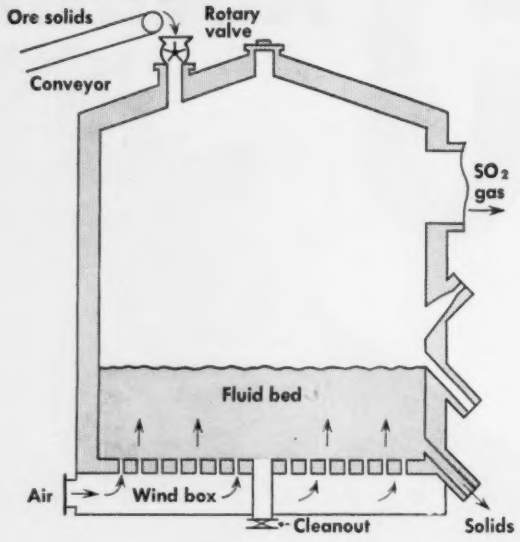
Temperature averages 1,200 F. in the bed—which has a 5-ft. depth. Detention time is 5½ hr.

Sulfur dioxide bearing gas passes into a two-compartment cooler, where twenty high pressure water sprays bring the gas temperature down from 1,200 to 800 F. From the cooler the gas stream passes through three cyclones for removal of entrained solids. Further cleaning and cooling (to 100 F.) is done in a wet scrubber, before the gas (12% SO_2) goes to the acid plant.

▶**After Roasting**—The Chemico acid plant is designed to produce 450 tons of sulfuric acid (100% equivalent) in the form of commercial 93% and 98% strength.

Sulfric dioxide gas, from the roasters, is piped to the Peabody scrubber (acting as both gas cooler and scrubber). Cooling water is introduced onto the top tray and drained from the bottom tray to an overflow box. From here the liquid is pumped through sprays into the humidifier section of the tower, then through the stripper located under the scrubber.

* A low-grade sulfur ore. Elemental sulfur is 25-30%.



Air, introduced at the bottom of the stripper removes most of the dissolved sulfur dioxide from the liquor. The stripper gases go to the scrubber, while liquor drained from the stripper is sent to the sewer.

Scrubbed gases flow into an electrostatic mist precipitator, operating with high voltage direct current.

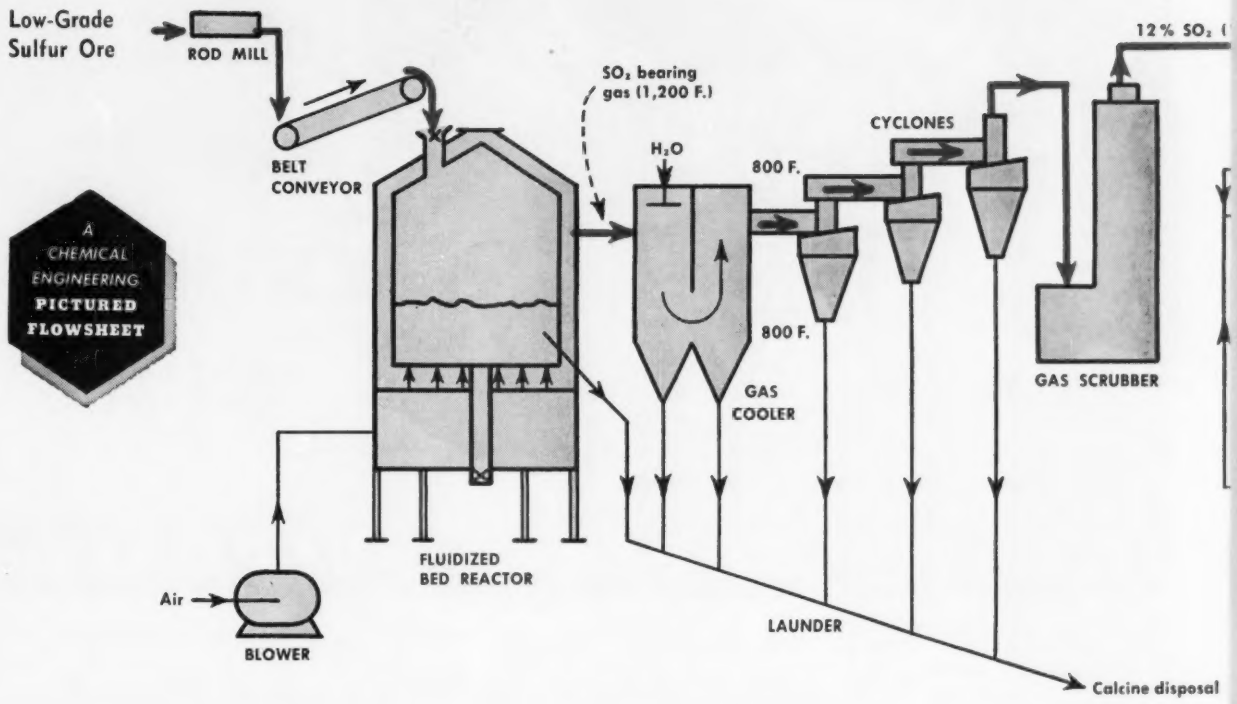
▶**Drying the Gas**—The gases then pass into a drying tower, where water vapor is removed with recirculated, 93% sulfuric acid. Water and 98-99% H_2SO_4 is added to the acid to maintain a 93% strength; part of this is taken off as product. Heat generated in the drying tower is removed by circulating the acid through cast iron coolers.

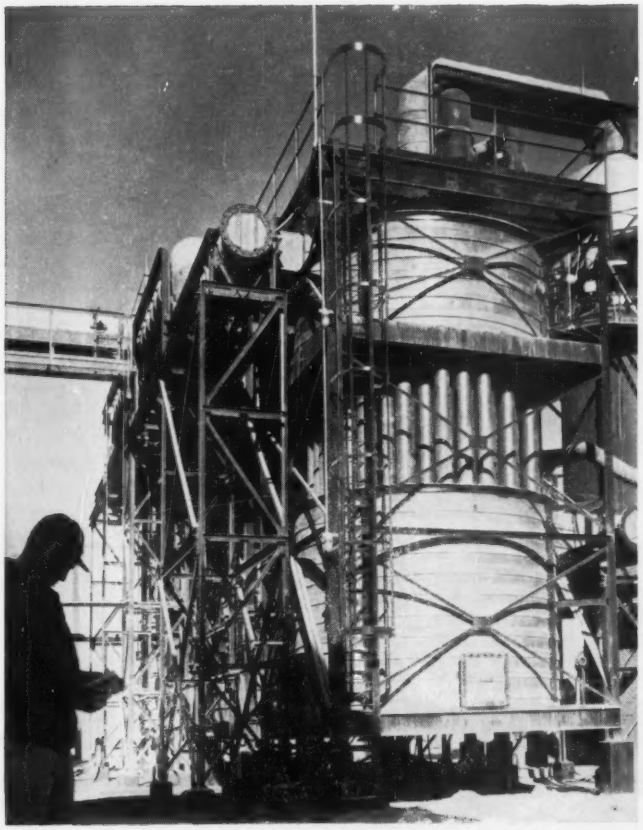
A motor-driven, centrifugal gas blower, located after the drying tower, picks up the relatively non-corrosive dry SO_2 gases. It operates so that there is 0 psig. at the outlet of the roaster cyclones and discharges at a pressure sufficient to force gases through the system.

▶**Converting to SO_3**—Gases leaving the blower are split into two streams. Each stream passes through three heat exchangers in series, bringing the gases to a temperature of about 840 F. at the primary converters.

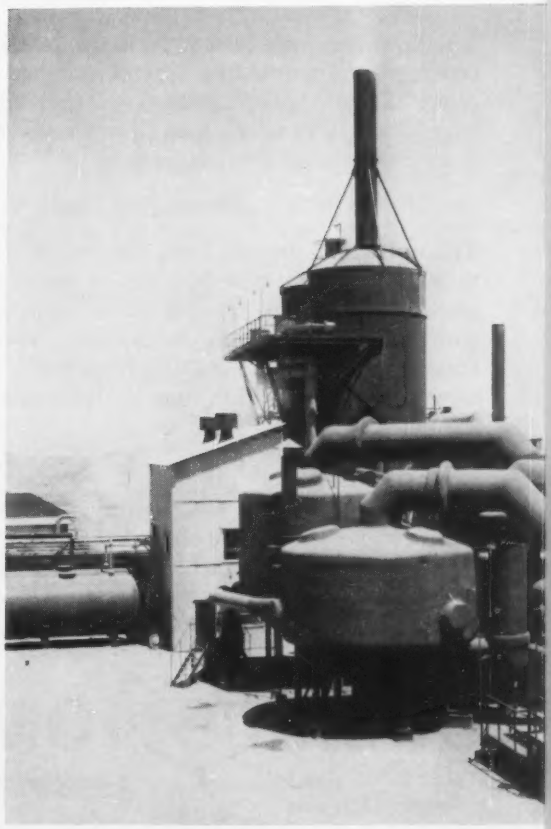
The heat exchangers and converters are so arranged that SO_2 gases leaving the main blower is preheated by SO_3 gases going to the absorption system. Partially converted gases from the primary converters are cooled by preheated SO_2.

▶**Making Sulfuric Acid**—The SO_3 gases leaving the converter-heat exchanger system pass through an absorbing tower where they are absorbed in 98-99% sulfuric acid. Acid strength is controlled by adding 93% sulfuric. Heat is removed in cast iron acid coolers.

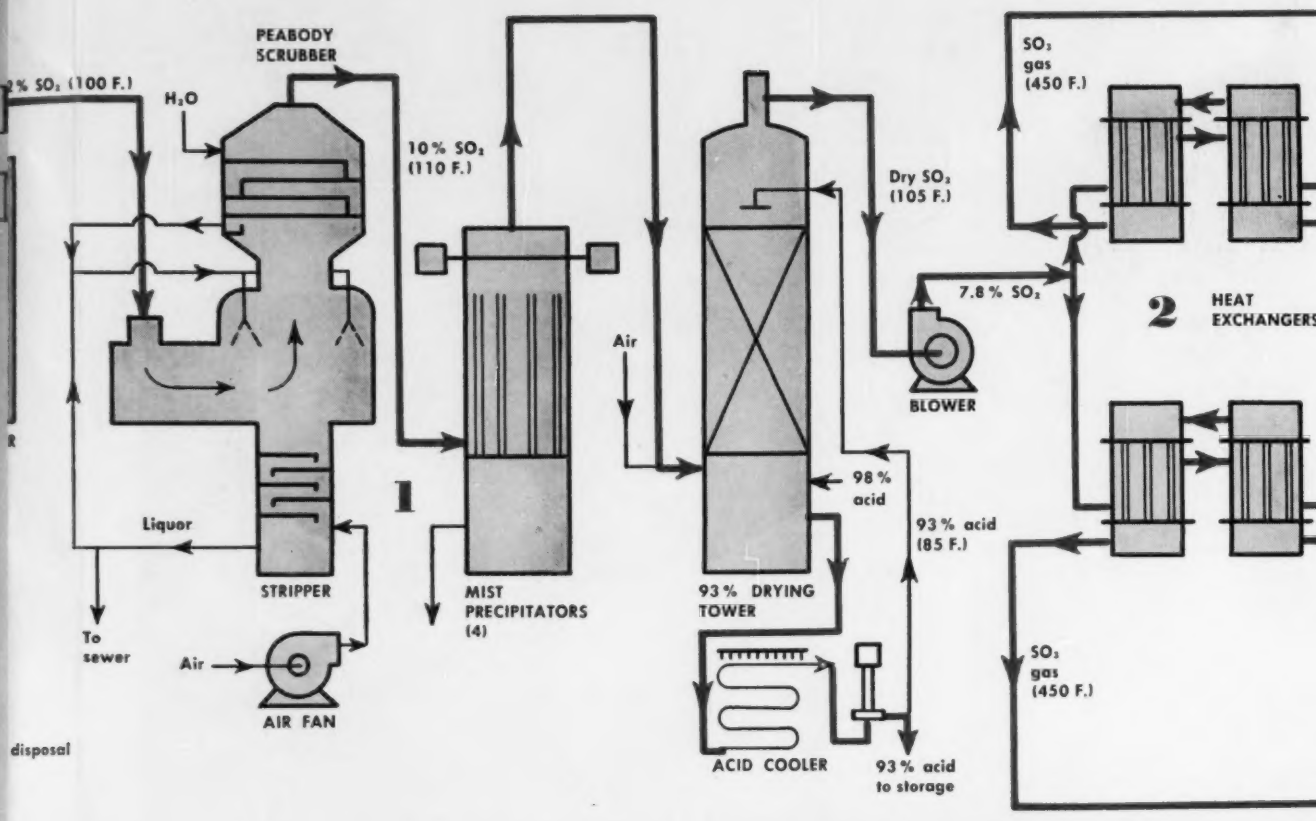




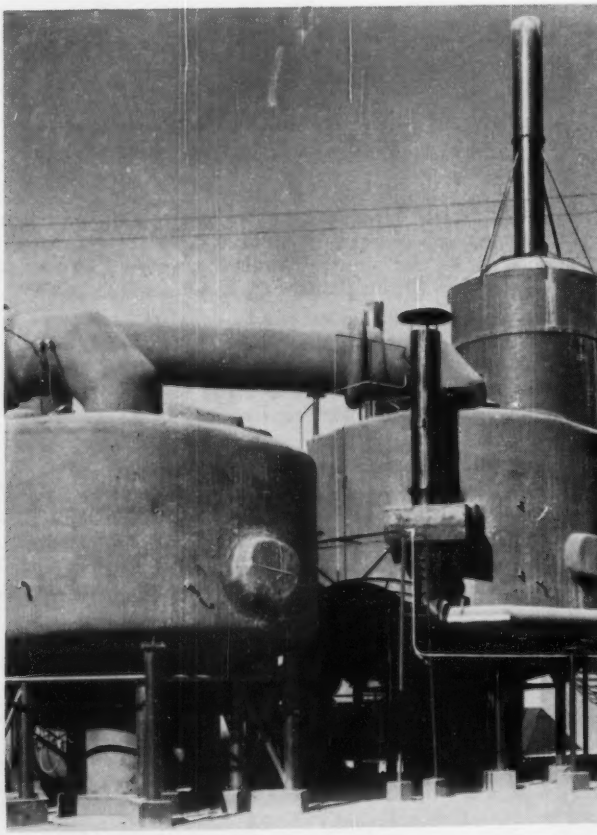
1 **SCRUBBERS** and electrostatic precipitators, remove dust, water vapor and acid mist from the SO_2 gas.



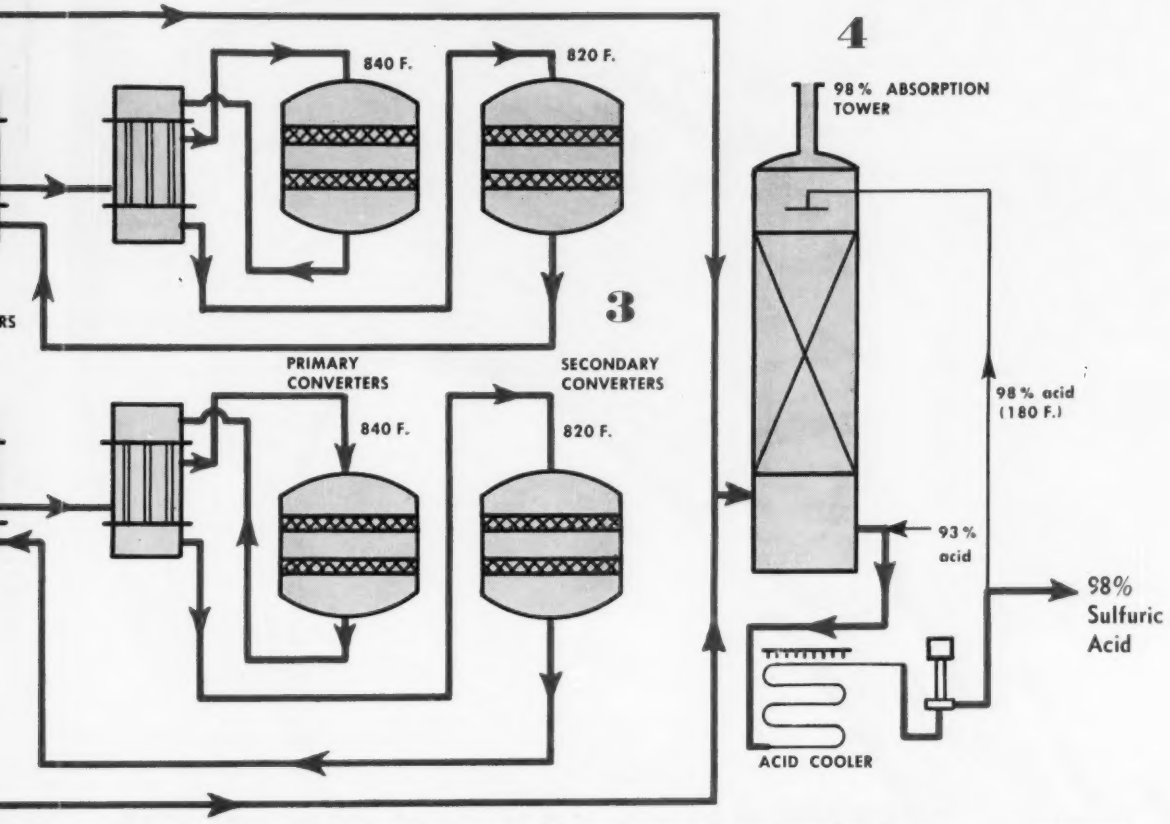
2 HEAT EXCHANGE SYSTEM. Here SO_2 gas leavin the primary converters. The SO_3 gas from the conver

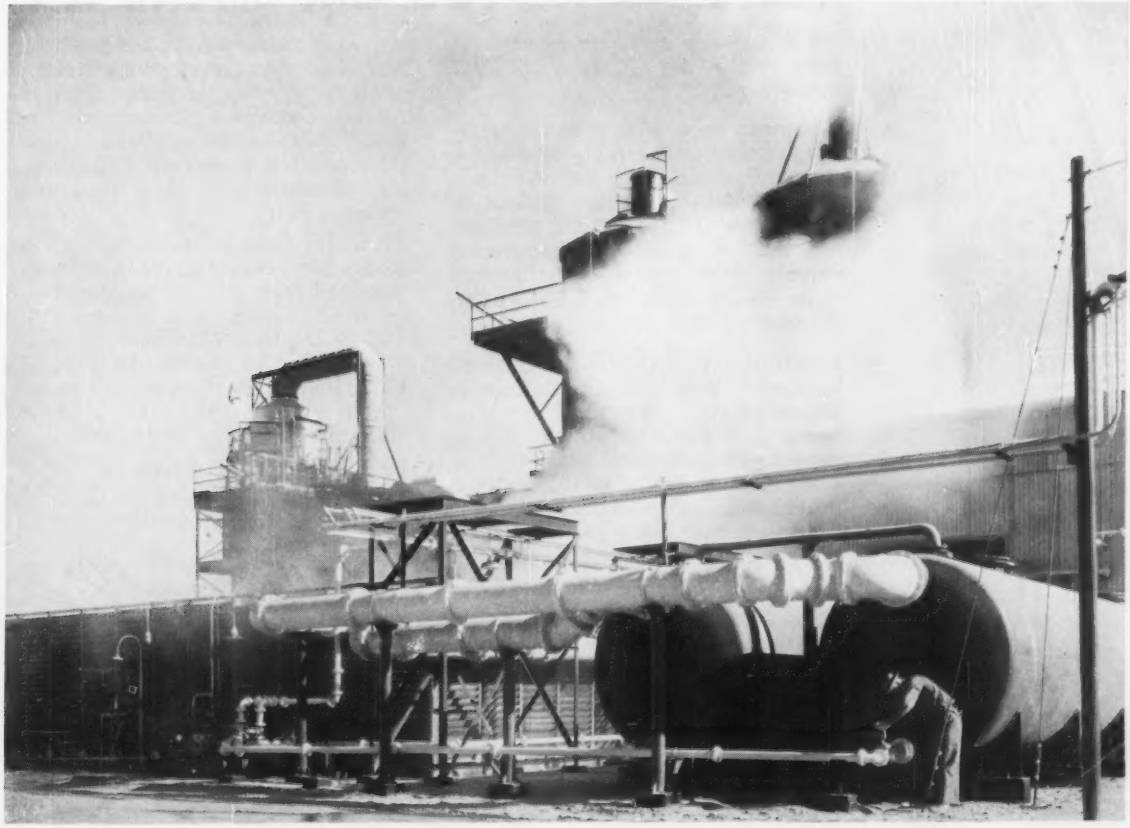


s leaving the main blower (foreground) is heated to 840 F. before entering
e converters is cooled to 450 F. before leaving the system.



3 CONVERTERS, primary and secondary, are packed wi vanadium catalyst. Temperatures are kept above 830 F.





4 ABSORPTION SYSTEM for concentrated sulfuric acid. A 98% acid is made by absorption of SO_3 in 93% acid—which in turn is produced in the SO_2 drying tower. Both concentrations are used in the Yerington operations.

PERFORMANCE YOU CAN DEPEND ON

For a pipe line in the oil country . . . for a ship at sea . . . for a jet plane in flight . . .

Whatever your high-pressure, high-temperature sealing problem may be, Flexitallic Spiral-Wound Gaskets provide *performance you can depend on.* That is why blueprints and purchase orders so often note the engineering department's gasket requirements thus: GENUINE FLEXITALLIC GASKETS ONLY.

Flexitallic Spiral-Wound Gaskets have made important contributions to almost every engineering development since 1912 — atomic energy, power plants, chemical processes, aircraft design. From this storehouse of experience, we provide the one right gasket for every job — an extra margin of safety, longer service life, and increased economy of operation.

Each Flexitallic Gasket is designed and engineered to meet specific conditions of thermal and physical shock, corrosion, vibration, weaving and unpredictable joint stresses. Spirally-wound V-crimped plies of required metal with alternating plies of proper filler result in a resilient gasket having characteristics of a calibrated spring.

Flexitallic Gaskets are at highest efficiency when bolted up cold at a predetermined load. For all pressure/temperature ranges from vacuum to 10,000 lbs., from extreme sub-zero to 2000°F. For all standard joint assemblies. In four thicknesses for special requirements: .125", .175", .250", .285". In diameters to 84" O.D.

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8th & Bailey Sts., Camden 1, N. J.
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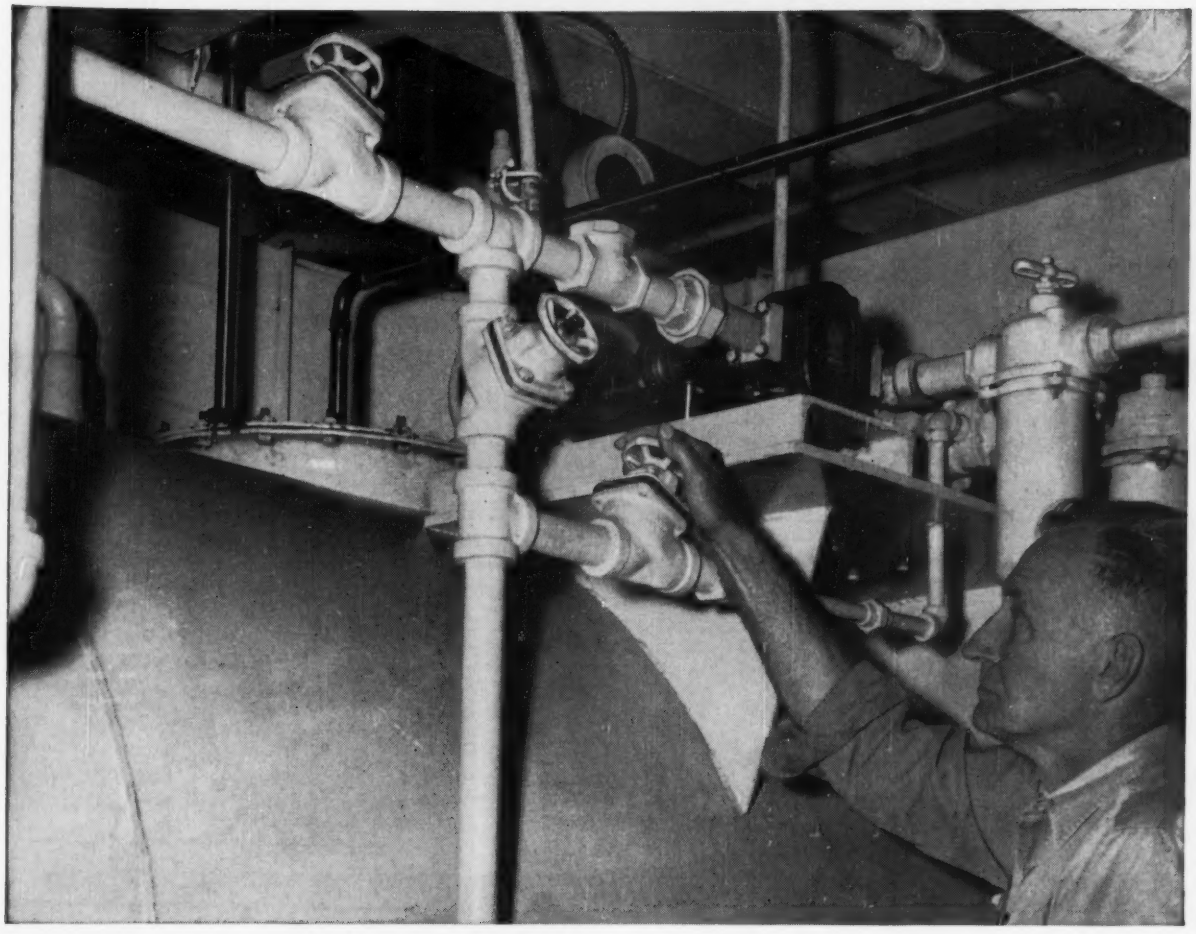
SPIRAL-WOUND GASKETS

FOR PIPE FLANGES, PRESSURE VESSELS AND PROCESS EQUIPMENT

TEFLON FOR PROCESS APPLICATIONS

The ideal seal for many process applications is a Flexitallic Gasket with Teflon trapped between edges of stainless steel. Ask for folder, "Teflon in Flexitallic Gaskets."

*Not all spiral-wound gaskets are Flexitallic. Look for *Flexitallic Blue* —it's our exclusive blue-dyed Canadian asbestos filler.



Light oil meets its master in these CRANE VALVES

THE CASE HISTORY— Read how the Johnson & Johnson baby products plant at Cranford, N.J., completely stopped a valve leakage condition that wasted product . . . caused a safety hazard . . . and menaced the plant's high sanitation standards.

Valves formerly used on very light baby oil lines were the source of trouble. Keeping them tight at the stuffing box was next to impossible. Constant servicing of stuffing boxes was necessary, even after repacking every 4 to 8 weeks. Several packings were tried without success while the high maintenance costs and nuisance conditions continued.

Early in 1951 the plant found the solution in Crane No. 1610 Packless Diaphragm Valves. They removed the cause of leakage —immediately stopped its troubles and costs. Almost 4 years later—with no maintenance whatsoever—the Crane packless valves remain absolutely tight; continue giving perfect service. And that goes for all valves added since the first installation.

Crane No. 1610 Packless Diaphragm Valves

When you have valve problems with hard-to-hold fluids, try Crane *Packless* diaphragm valves. They eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Their diaphragm has longer life, yet should it fail, their separate disc prevents escape of line fluid. Available in wide selection of materials and sizes. Ask for folder AD-1942 or see your Crane Representative.

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VALVES • FITTINGS • PIPE • PLUMBING • HEATING

CRANE'S FIRST CENTURY . . . 1855-1955

4 OPERATIONS COMBINED INTO 1 SIMULTANEOUS PROCESS

Flash Drying

DRYING
GRINDING
SEPARATING
COOLING

BASIC COPPER SULPHATE

This typical Flash Drying operation shows a modern method of processing powdered materials, which may be applied to many different products with assured economies.

•

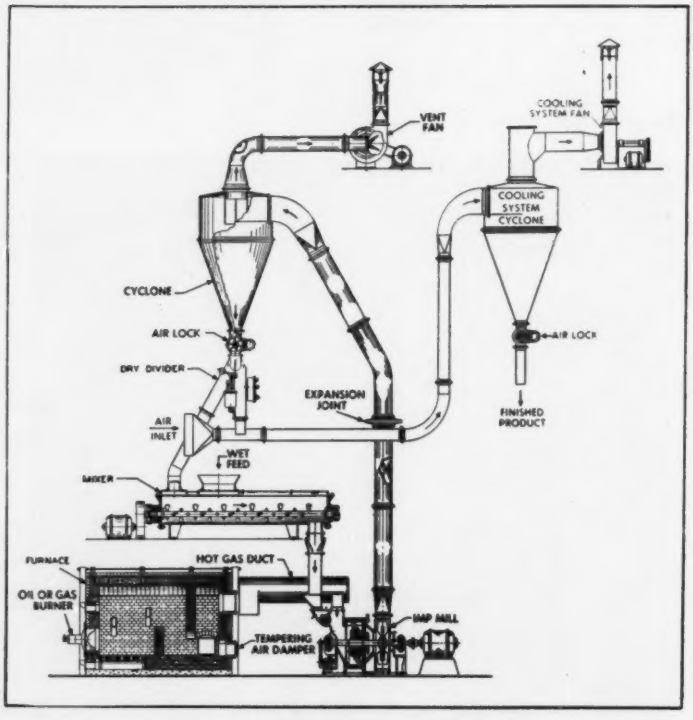
The flow diagram at the right represents a compact *drying-grinding* system for handling Basis Copper Sulphate. A Raymond Imp Mill is used with Flash Drying accessories and air cooling equipment.

•

The mill takes the wet feed, containing up to 50% moisture, and removes a definite amount of water of crystallization, ending with less than 1% moisture content. The finished product is discharged from the cyclone collector through the cooling unit ready for bagging.

•

Ease of installation, low power requirements, high heat efficiencies, shortened production time, close control of particle size and moisture content, are some of the advantages of Raymond Flash Drying.



For details of many other applications write for Raymond Flash Drying Catalog #54-A

COMBUSTION ENGINEERING, INC.

Raymond Division

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Chicago 22, Illinois

Sales Offices in Principal Cities

William P. Drake: Man of the Month

Newly-named president of Pennsalt started his career with the company in plant maintenance.

A bit of pioneering in the matter of student training programs paid a big dividend to Pennsylvania Salt Manufacturing Co. Over 20 years ago Pennsalt became one of the first chemical companies to hire college students for a summer training program. Last month, the first student to take part in the program, William P. Drake, was named president of the company.

Only 42, Mr. Drake is the youngest president in the firm's 105-year history. Although he began his career in the plant, many of Drake's 21 years with Pennsalt have been in sales and sales administration.

In 1952, he went to Washington to serve a 6-month term as director of the Rubber, Chemicals and Drugs Div. of the Office of Price Stabilization. On returning to Pennsalt, he again demonstrated his executive talents in some of the company's top level posts.

▶ **Start in Plant**–But Bill Drake needed no executive ability for his first job on the then-new training program. He was in the sophomore year of his liberal arts course at Maine's Bowdoin College at the time–a big, husky center on the football team and coach and leader of the glee club–a rare combination.

Pennsalt put him to work lugging and painting Cl_2 cylinders, raking the yard and filling in on the maintenance crews at its Wyandotte, Mich., plant.

About his first job, Bill recollects, "In those days the training program's prime purpose was to see whether or not a fellow delivered an honest day's work. The work itself was often hard and dirty, but we had a lot of fun and got to appreciate the problems of the people in the plant."

After spending two more summers in maintenance and operations work in other Pennsalt plants, and after getting his degree from Bowdoin, Bill accepted Pennsalt's offer of a full-time job.

▶ **Worked in Sales**–Production work on the metal cleaner, sodium orthosilicate, led Bill to the job of selling it. Selling appealed to him from the start. He enjoyed meeting people, he had a taste for the give and take of the sales interview, the "being on your own" and, besides, he had just gotten married and right then sales seemed to hold better prospects for advancement than manufacturing work.

Orthosil, as the new cleaner was called, made a salesman out of Bill the hard way. Though it could outperform other metal cleaners of the day, it cost more–and in those depression days the price tag often blocked a sale before Bill could set down his brief case.

Here, his experience in the plant aided him. Knowing the product and knowing how to talk the production man's language helped him skirt many a purchasing agent to retrieve "lost" sales.

Orthosil caught on and fostered the development of companion products and when Pennsalt welded these into a Cleaner Div., it named Drake manager. Later this division was merged with the Chemical Specialties Div. and Drake took over as sales manager for the new group. Here he learned one of his most important business lessons.

▶ **Learned Lesson**–Bill was a longtime admirer of his predecessor in Chemical Specialties. And, being rather young and not completely sure of himself, he tried to weigh every decision and take every action as he imagined his predecessor might. As Bill puts it: "I tried to ape him and I fell flat on my face."

Eventually, Bill learned to be himself and to make his decisions on his own terms and in his own way. The department prospered and in 1947 Pennsalt raised Drake to assistant vice president, sales. Two years later he was named vice president in charge of sales.

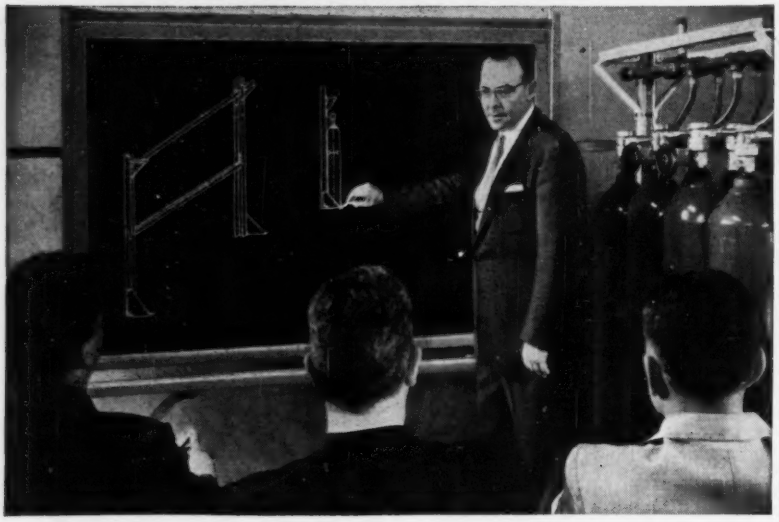
▶ **Comes to Top**–Bill directed the company's sales organization for about five years–with time out for his stint in Washington with OPS. During his tenure the company introduced several successful products, including a line of fluorine-based chemicals.

Early last year, company expansion prompted the forming of two new major operating divisions and Drake became general manager of one. Last February, when former president, George B. Beitzel, announced his intention of retiring, the company appointed Drake executive vice president and elected him a director.

This eased the transfer of responsibility which culminated last month in naming Drake as president. It also set Bill to the job of readying a 5-year company expansion plan.

▶ **Closing a Sale**–Characteristically, he did not work up a plan and then hand it down for the organization to execute. The new plan is mak-

GREATEST FIRE FIGHTING DESIGN ADVANCE IN 25 YEARS!



This Kidde Automatic Pressure-Operated CO_2 Extinguishing System is *brand new from the floor up!*

✓ CHECK THESE 10 FEATURES!

☐ **1. NO FALLING WEIGHTS**—No clumsy mechanical triggering methods. Pneumatic or Electrical Control Heads automatically trigger CO_2 cylinders, assure complete discharge!

☐ **2. SELF-ENCLOSED PARTS**—All moving parts of the new Kidde system are self-enclosed to prevent fouling or accidental operation!

☐ **3. EASIER INSTALLATION**—New racking arrangement is pre-drilled at the factory, eliminates need for special hangers, tools or outside material! Can be either "free standing" or wall mount.

☐ **4. NO PARTS TO REPLACE**—Even after a fire, operating parts of the new Kidde system can be re-set with a screwdriver. No parts need be replaced. Refill cylinders and system is ready for operation!

☐ **5. SIMPLE, THOROUGH TESTING**—By merely disconnecting control heads from cylinders, *all* operating parts (other than actual discharge of CO_2 gas) can be tested *in place!*

☐ **6. QUICK VISUAL INSPECTION**—All primary actuating parts fitted with easy-to-read visual indicator. Shows at a glance if system is "set" or "released."

☐ **7. MULTIPLE PROTECTION**—Automatically-operated Directional Valves let you protect more than one hazard from the same bank of cylinders!

☐ **8. SIMPLIFIED WEIGHING**—New racking arrangement lets you weigh CO_2 cylinders right in place without disconnecting them, providing uninterrupted fire protection even while cylinders are being weighed!

☐ **9. NO OUTSIDE POWER NEEDED**—The new Kidde system is completely self-contained, has rate-of-temperature-rise detectors which give sure protection even in case of outside power failure!

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ing its way up through the ranks, level by level. At each step on the organizational ladder, plans developed by the groups below are combined, worked over and modified to fit a "What's good for the company as a whole" philosophy and passed on up. The emerging company plan will then be the sum of the division plans.

As Drake points out, not only is it good training for men at all levels to think ahead and dope out what their group should be doing five years hence and why, but since the men develop the plan themselves, it's already been sold to them. And Bill never forgot how to close a sale so all concerned could benefit.

► **Family Man**—A strong family man, Drake's principal recreation is sailing his schooner on Chesapeake Bay and along the Maine coast. "The boat," he says, "keeps the family together for fun and relaxation."

Though he looks as trim and as fit as in his football-playing days, Bill says that nowadays he has little time for sports. He claims he now gets most of his exercise working around his Berwyn, Pa., farm and playing with his five children and their innumerable pets.—HTS

John D. Odle, William V. Brown, Pierre F. Gunder and James A. Long, Jr.—Joined the research and development division of the Davison Chemical Co., Division of W. R. Grace & Co.

William H. Schuette—General manager of Dow Chemical Co.'s Midland division.

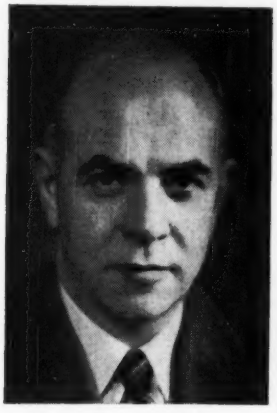
Samuel Lenher—Elected a director, vice president and member of the executive committe of the Du Pont Co. **George E. Holbrook** succeeds Mr. Lenher as assistant general manager of the company's organic chemicals department.

Pascal M. Rapier—Process engineer at Eagle-Picher Co.'s Clark, Nev., plant, where "Celatom," the company's diatomaceous silica, is processed.

S. Carroll Young—Production superintendent for Gamma Chemical Corp. Mr. Young was formerly superintendent of production at General Aniline & Film Corp.'s Linden, N. J., plant.

R. B. Robinette—Resigned as president of General Paint Corp. of San Francisco. **Sidney C. Rasmussen, Sr.**, a director and former president, will serve as acting president. Mr. Robinette remains on the board of directors.

Marion E. Dice—Appointed assistant to the president of General Petroleum Corp. **W. F. Kirk** succeeds Mr. Dice as manager of the company's economics department.



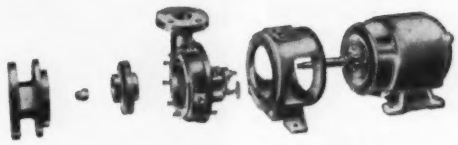
William H. Bowman

Dr. Bowman has been appointed assistant general manager of the organic chemicals division, American Cyanamid Co. He has been associated with Jefferson Chemical Co., Inc. for the past ten years and since 1951 has been a vice president of Jefferson, which is jointly owned by American Cyanamid and the Texas Co.

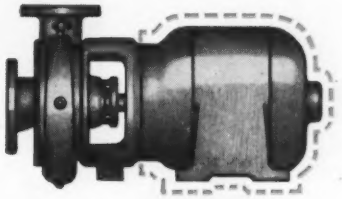
Raymond E. Kirk—Retired as head of the chemistry department, Polytechnic Institute of Brooklyn. Dr. Kirk will continue his duties as dean of the graduate school and professor of inorganic chemistry.

Melvin De Groote—Awarded the degree of Doctor of Science by

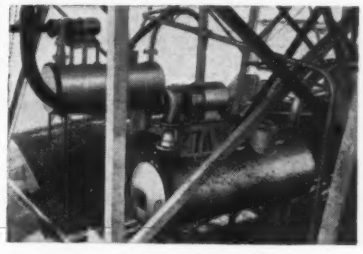
Q.E.D. ...which was to be demonstrated



uality of Ingersoll-Rand Motorpumps is evidenced in the extra-heavy, extra compact design and construction shown above. From suction to discharge a Motorpump is built to the highest standards that can be established.



fficiency is shown by smaller motor hp required to drive the I-R Motorpump. The impeller is precision balanced for peak performance. Design permits short shaft to eliminate deflection and whip. From packing to pump-casing, parts are engineered to make a smooth operating machine that delivers the goods—on every job.



urability is proved by the illustration above. These I-R Motorpumps were installed 4 years ago and paid for themselves in the first 90 days of service. Service is both rugged and continuous, yet, in all this time, there has been no maintenance downtime.

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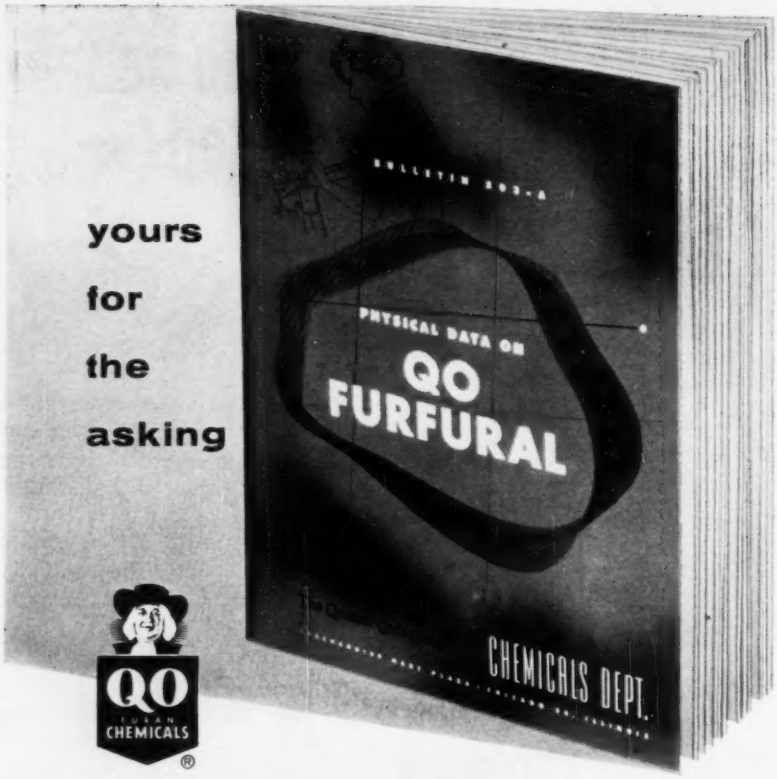

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NAMES . . .

Ohio State University. Dr. De Groote is vice president in charge of research development and patents for the Tretolite Co.

Harold C. Weingartner

Mr. Weingartner, formerly vice president of National Research Corp., has joined the staff of Welling & Woodard, industrial consultants. He will head a new department devoted to product development and diversification for clients in the process equipment and chemical industries. Mr. Weingartner has had extensive experience in the development of chemical and physical processes and in the design, manufacture and sale of advanced types of process equipment. Before his association with National Research Corp., he was with the National Defense Research Commission, University of Illinois and with Standard Oil Co. (Ind.).

Alexander L. Naylor—Elected president of the Fairbanks Co. Mr. Naylor succeeds his father, **George M. Naylor,** who was president until his death in April.

Robert L. Bebb—Manager of research and development of the synthetic rubber and latex division of Firestone Tire & Rubber Co.

Emert S. Pfau—Appointed technical director of General Tire & Rubber Co.'s chemical division. **Richard A. Briggs** is head of polymerization research on olefinic materials for the company.

Sheldon Allen—President of Leslie Salt Co., succeeding **Fred B. Bain** who is honorary chairman of the board.

John M. McConney—Assistant applications engineer for Niagara Filters Division of American Machine and Metals, Inc.

G. Daniel Davis—Named to the post of executive vice president of Nopco Chemical Co.

Earl C. Petrie—Appointed director of research of North American Refractories Co.

C. Herbert Quick—Appointed assistant to the director of research and development of Norton Co.

O. Kenton Neville—Named director of the technical division of Nuclear Instrument and Chemical Corp., Chicago.

Thomas C. Sutton—Appointed vice president in charge of all manufacturing for OPW Corp., manufacturer of valves, fittings and assemblies.

John E. McKeen—Awarded the Legion of Honor by the French government. Mr. McKeen is president of Chas. Pfizer & Co., Inc.

Henry L. Hillman—President of Pittsburgh Coke & Chemical Co. **R. M. Marshall** is chairman of the board.

Norman Walton—Appointed engineering assistant to Chief Engineer **Harold Moorhead** at Powell River Co.'s pulp and paper operation, Powell River, B. C.

Gardiner Symonds—Chairman of Petro-Tex Chemical Corp., newly formed by Tennessee Gas Transmission Co. and Food Machinery and Chemical Corp. Mr. Symonds is president of TGT.

Robert W. Harper—Named resident manager of a new paper mill planned at Longview, Wash.,

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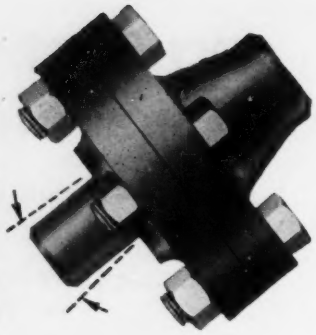

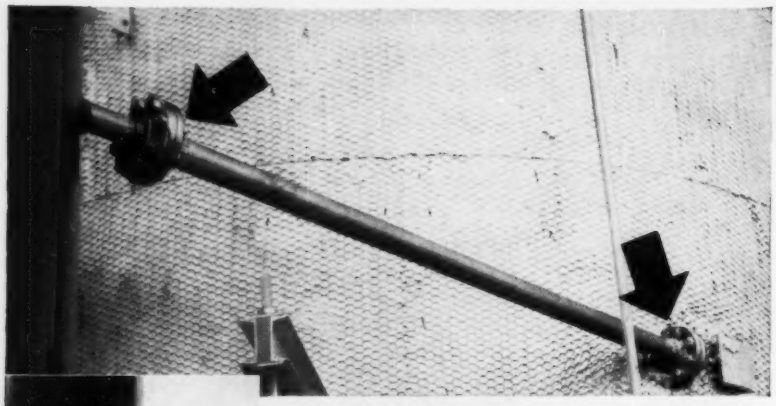

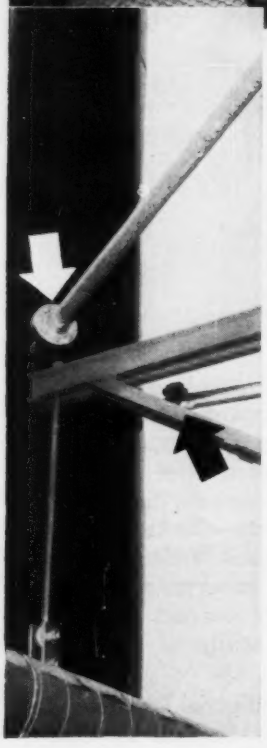

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NAMES . . .

as a joint venture of Rhinelander Paper Co. and Weyerhaeuser Timber Co.

H. I. Wolff—Named to a newly created post of assistant manager, manufacturing-development department, Shell Chemical Corp. **Bedrich V. Hettich** has been appointed chief technologist at the company's Denver plant.

A. R. Goldsby—Director of research for Stratford Engineering Corp., Kansas City, Mo.

John McColgan—Appointed director of development, Stauffer Chemical Co.'s container division. **Charles A. Lindsay** has been appointed general manager of the division, with headquarters in Los Angeles.

Bernard Kopelman—Chief engineer of Sylvania Electric Products Inc.'s atomic energy division.

Ernest G. Brown—Elected chairman of the board of directors of Texas-U. S. Chemical Co., succeeding **John P. Coe** who retired. Mr. Brown will continue as vice president of U. S. Rubber Co., but will relinquish his post as general manager of U. S. Rubber's mechanical goods division.

G. Allen Lovell—Elected a vice president of U. S. Rubber Co. and appointed general manager of its mechanical goods division.

Roland Voorhees—Appointed associate director of development for the chemicals and plastics divisions of Union Carbide and Carbon Corp.

Sterling P. Blumberg—Senior research chemical engineer in the research and development division of Humble Oil & Refining Co.'s Baytown, Tex., refinery. **C. J. G. Leesemann** is a research associate in the research and development division; **I. D. Hall** and **P. N. Kuehler** are technical associates in the technical service division.

Frank Casso, Jr.—Manager of laboratory and manufacturing of the Glidden Co's international business department.

A. A. Markson—Assistant vice president in charge of engineering for Hagan Corp., Pittsburgh instrument and control firm.

C. Roger Sutton

Mr. Sutton, senior metallurgist at the Argonne National Laboratory of the U. S. Atomic Energy Commission for the past five years, has joined the development and research division of International Nickel Co., as a member of the stainless steel and heat resistant alloys section. Prior to his appointment at Argonne in 1950, he had served for five years as general consultant. Between 1928 and 1945, Mr. Sutton was successively affiliated with Gemmer Mfg. Co., Forging & Casting Corp., Solvay Process Co., Halcomb Steel Co., Chrysler Corp. and General Alloys Co. He is chairman of the project advisory committee of the Casting Potentials Project, AMC.

David A. Palmer—Member of the research department of Monsanto Chemical Co.'s plastic division. **Roland A. Labine, Jr.** and **Walter J. Mings** are new members of the division's engineering department.

John W. Palmer—Vice president and treasurer, Hyland Laboratories. Dr. Palmer, also appointed to the board of directors, will

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NAMES . . .

continue as director of the laboratories.

Harold M. Alexander—General manager of research and development for Libbey-Owens-Ford Glass Co. **Joseph D. Ryan** is the company's new director of research.

L. W. Sessions—Named assistant to the general manager of the development division of Monsanto Chemicals (Australia) Ltd.

Philip M. Dinkins

Mr. Dinkins has been elected vice president-operations, dyestuff and chemical division of General Aniline & Film Corp. From 1946 to 1955 he was president and director of the Jefferson Chemical Co., Inc. And from 1944 to 1946 he served as vice president and general manager of the company. Mr. Dinkins had been associated with American Cyanamid since 1923.

Murlin T. Howerton—Appointed chairman of the chemical engineering department, University of Denver.

Hamnett P. Munger—Chairman of the chemical engineering department, Syracuse University. Dr. Munger was formerly technical research adviser for the Battelle Memorial Institute.

Theodore S. Hodgins—Director of the chemical and rubber division of the Business and Defense Services Administration, U. S. Dept. of Commerce. Mr. Hodg-

ins is vice president in charge of the Pacific Northwest Division of Reichhold Chemicals, Inc.

Langbourne M. Williams–Chairman of the National Industrial Conference Board. Mr. Williams is president of Freeport Sulphur Co.

Ray P. Dinsmore–Awarded the Charles Goodyear Medal for 1955 by the Rubber Division, American Chemical Society. Dr. Dinsmore is vice president in charge of research and development for Goodyear Tire and Rubber Co.

C. P. Neidig–President of the Chemical Market Research Association. **E. M. Ott** is president-elect.

William B. Tarpley–Head of Aeroprojects Inc.'s laboratory responsible for ultrasonic applications in the chemical and chemical engineering fields.

Carl F. Freedman–Executive vice president of American Agile Corp., producer of plastic materials and other corrosion-resist- and products.

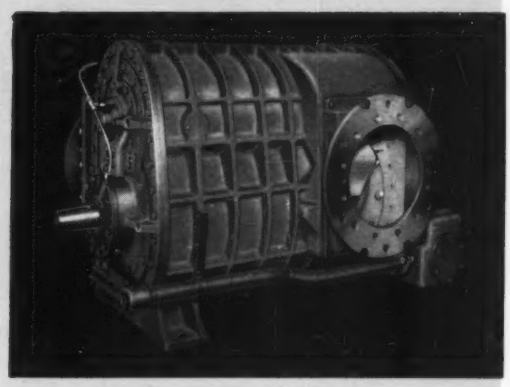
Raymond L. Cassell–Divisional chief plant engineer for the organic chemicals division, American Cyanamid Co.

A. L. Jackson–Director of engineering for American Enka Corp., succeeding **P. P. Kriek** who retired.

Paul McClay–Assistant vice president of Archer-Daniels-Midland Co.

Donald J. McPherson–Assistant manager of the metals research department, Armour Research Foundation. Dr. McPherson is an expert in the field of titanium and its alloys.

Thomas D. Cabot–Elected a director of the Committee for a National Trade Policy and a trustee of the Committee for



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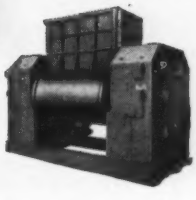

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NAMES . . .

Economic Development. Mr. Cabot is president of Godfrey L. Cabot, Inc.

William Naden

Mr. Naden has been elected executive vice president of Esso Standard Oil Co. A director of the company since 1946 and a vice president since 1950, he succeeds Marion W. Boyer who has been elected a director of Standard Oil Co. (N. J.). In the 28 years he has served with the company Mr. Naden has held a number of positions including: general superintendent of the Everett, Mass., and Baltimore refineries; manager of employee relations and general manager of manufacturing. During World War II he served as director of District I, Petroleum Administration for War.

Herbert Kay—Appointed manager of new chemical development in the chemical division of Climax Molybdenum Co.

Frank F. Elliott—Elected president and chief executive officer of Crane Co. Mr. Elliott succeeds **John L. Holloway**, who resigned as president and director because of ill health.

Robert J. Musser—Named assistant manager of the market research department, Carbide and Carbon Chemicals Co., Division of Union Carbide and Carbon Corp.

Howard R. Medici—Elected president of the Visking Corp.,

succeeding the late **J. Paul Smith.**

J. C. Brigham—Chief engineer of Wallace & Tiernan Inc., Belleville, N. J.

John H. Schmid—Appointed research engineer for J. A. Zurn Mfg. Co., Erie, Pa. Mr. Schmid will coordinate field research, development and testing of Zurn-engineered building drainage control products for Zurn Research and Development Corp., affiliate of Zurn Mfg.

OBITUARIES

S. M. Swain, vice president in charge of research for North American Refractories Co., died May 22 after a short hospital confinement.

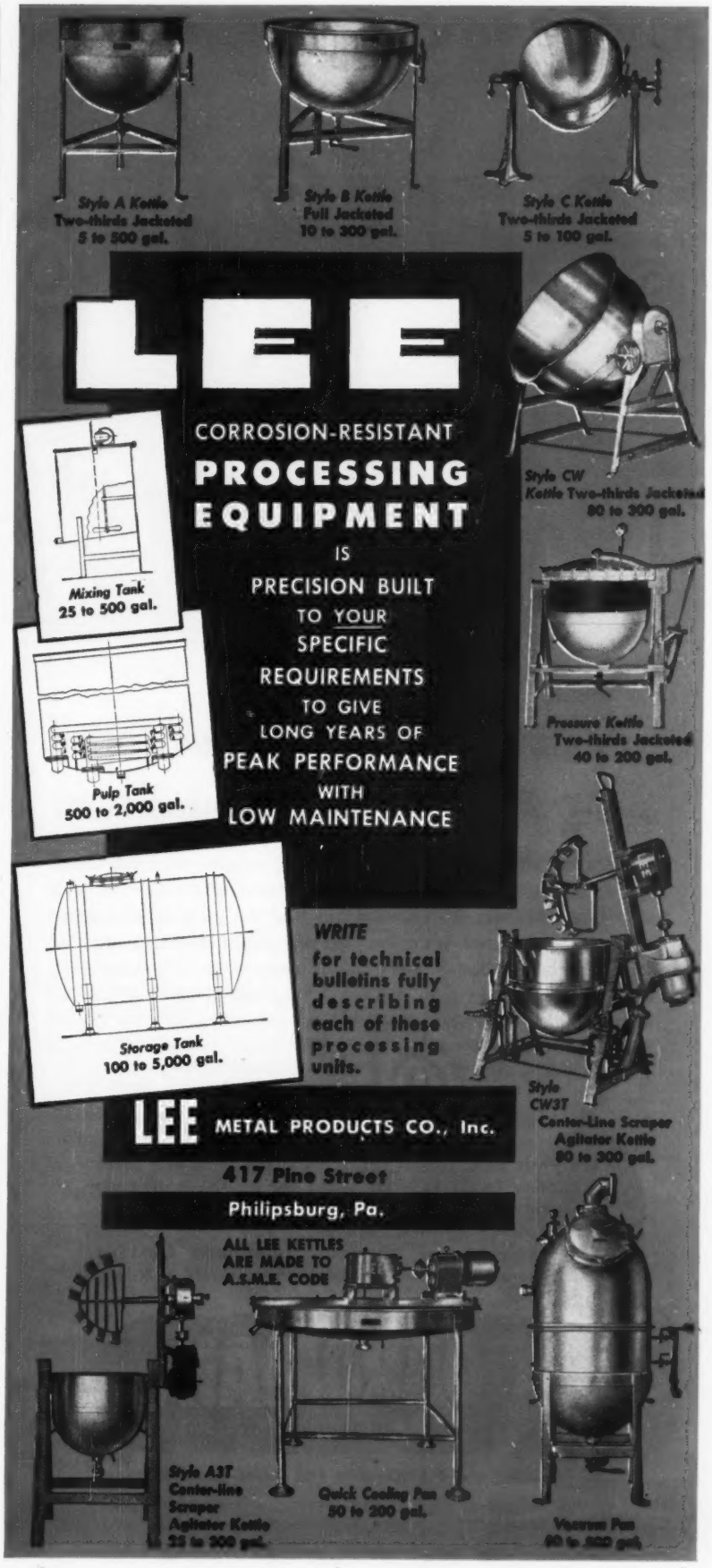
George F. Wilkins, 47, vice president of Jefferson Lake Sulphur Co., died suddenly in Wendell, Idaho, on May 24. Prior to his joining Jefferson, Mr. Wilkins was, for many years, associated with General Chemical Division of Allied Chemical & Dye Corp.

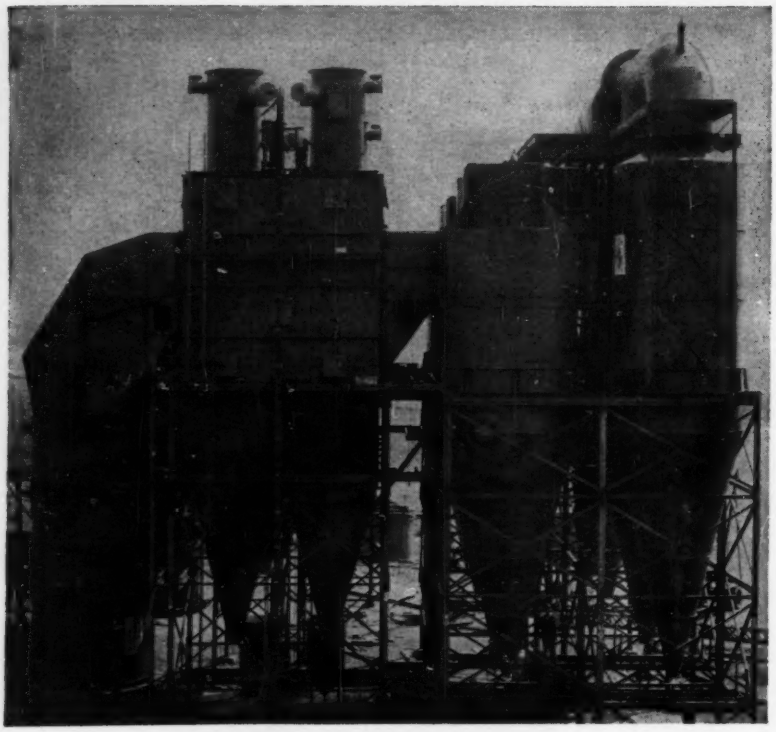
Richard N. Nason, 87, founder of R. N. Nason & Co., San Francisco paint manufacturing firm, died June 4 at his San Francisco home.

Howard R. Huston, 62, retired vice president and director of American Cyanamid Co., died suddenly on June 8 at his summer home in Truro, Mass. Mr. Huston retired from his Cyanamid post May 30 and had been serving the company as a consultant.

Allen V. Riley, technical sales representative for Atlas Powder Co. in the Houston, Tex., area, died on June 10 after an extended illness.

Harry L. Moat, director of production for the Atlas Powder Co. explosives department, died suddenly at his home in Wilmington, Del., on June 12. He was 58 years old.





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THIS MONTH'S

Technical

Management in Focus

MANAGEMENT AND LEADERSHIP. Revised edition. By Carl F. Braun. C. F. Braun & Co., Alhambra, Calif. 289 pages. $3.25.

"The mischief begins when, instead of calling forth the activity and powers of individuals . . . (leadership) substitutes its own activity for theirs; when instead of informing, advising, and upon occasion, denouncing, it makes them work in fetters, or bids them stand aside and does their work instead of them."

The author reinforces his text with many such quotations from the builders of our modern concepts of the reciprocal rights and duties of society (here represented by "the company" and its leaders) and the individual. Of all, this excerpt from John Stuart Mill best sums up the questions raised and debated in "Management and Leadership."

From the point of view of the continuing economic health and growth of a company, Mr. Braun explains why he believes "calling forth the activity and powers of individuals" is the only approach for management which leaves in its wake the solution to all corporate problems. Primary emphasis on any other aspect—be it profits or facilities or research—creates an imbalance which always ends in disaster.

The right way, according to Mr. Braun, can best be implemented by good company-wide communication, ". . . informing, advising, and upon occasion, denouncing . . ." He emphasizes the importance: for the higher-echelon leader, of written directives because they force him to provide a dependably organized guide not only for his workers but for himself; for the front-line leader, of teaching via concrete examples, relating new knowledge to the worker's experience to stimulate genuine interest. He proposes ways to achieve the delicate balance between understanding and

Bookshelf

L. B. Pope

discipline which good employees require of good leaders.

Also developed are the ideas: that good communications promote an invaluable team spirit by making each employee see his work in relation to the total company effort; that a man made to feel he is respected will live up to expectations.—FA

Deeper Probe

CATALYSIS. Vol. 2. Edited by Paul H. Emmett. Reinhold Publishing Corp., New York. 473 pages. $12.

Reviewed by F. C. Nachod

The second volume of this series probes deeper into the intricacies of catalytic behavior. Under the able editorial guidance of Dr. Emmett, contributors H. Eyring, Hugh M. Hulburt, W. B. Innes, Edward L. King, Ransom B. Parlin, Merrill B. Wallenstein, Ahlborn Wheeler and Bruno J. Zwolinski report competently on general theories, heterogeneous vapor phase and homogeneous liquid phase reactions, reaction rates, selectivity, nature of catalytic surfaces and complex formation.

The same high standards which characterized the first volume have been maintained and the series promises to be the outstanding compendium on catalysis.

Broad Perspective

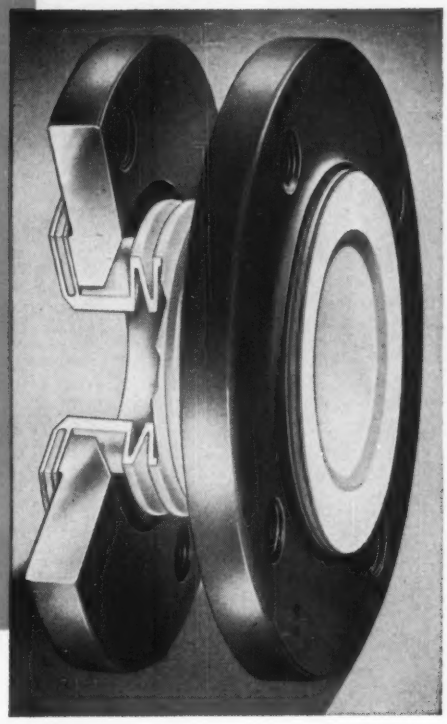
THE CHEMISTRY OF SYNTHETIC DYES & PIGMENTS. Edited by H. A. Lubs. Reinhold Publishing Corp., New York. 734 pages. $18.50.

Reviewed by M. R. Stevinson

The 19 contributors to this volume have succeeded in producing a creditable monograph dealing with a very complex and involved subject. The presentation is lucid and the selection and organization of material is generally commend-

JOHN CRANE announces

a complete line of TEFLON* BELLOWS with companion flanges



"John Crane" chemically inert, corrosion, heat and fatigue resistant bellows (made of Teflon) are now available furnished with companion flanges. Flanges conform to American Standard bolt hole circles and numbers.

Strength, service life and flexibility have been increased through development of a new convolution form. Bellows are formed at full free length, thus reducing residual and working strain to a minimum. Expansion and contraction in either direction takes place with equal freedom of motion. Operating temperature ranges from −300°F. to + 500°F. . . . pressures to 75 psi.

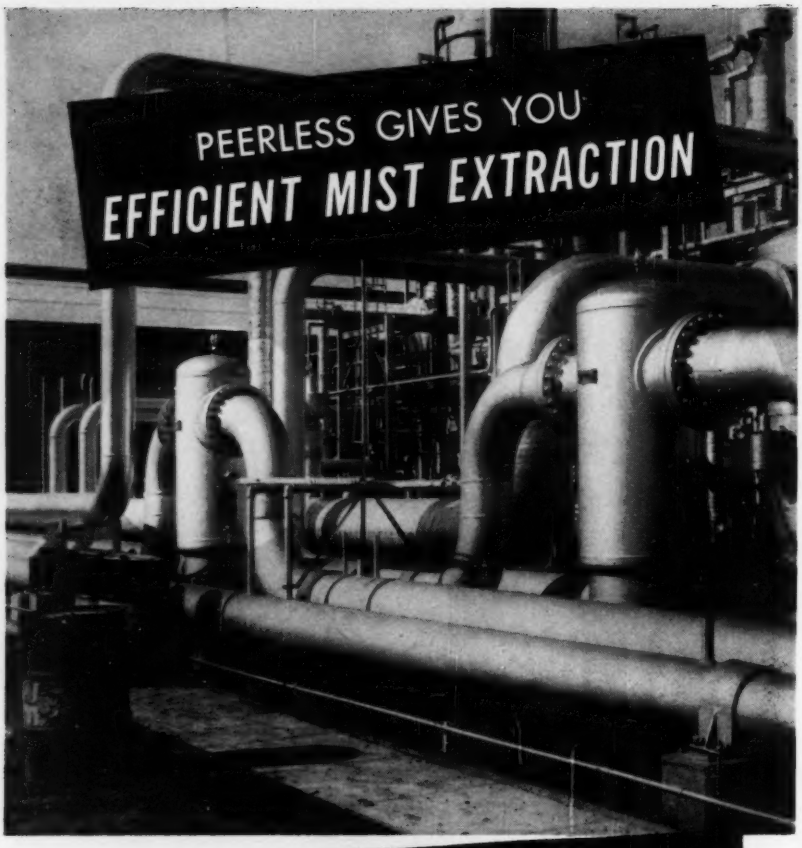
Bellows flanges are French-type gasket construction to provide highest possible sealing efficiency at low flange pressure. Resilient insert material is asbestos or synthetic rubber.

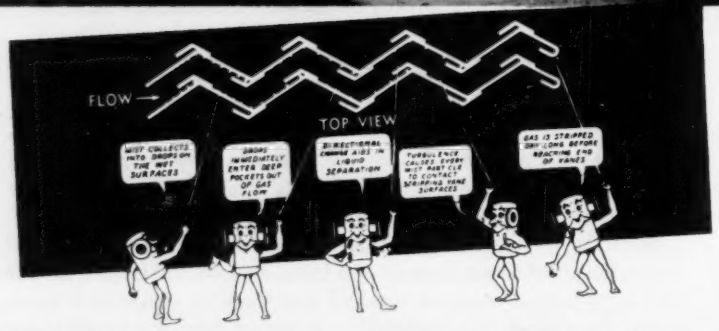
Investigate "John Crane" Teflon bellows with companion flanges for your "hard-to-handle" applications . . . vibration dampeners . . . expansion joints . . . flexible connectors. Supplied to fit any pipe size from ½" through 12". Other designs for metering pumps, pressure accumulators, batching scales, hydraulic systems and similar applications.

Contact "John Crane" for full information, including booklet, *The Best in Teflon*. Crane Packing Co., 1809 Belle Plaine Ave., Chicago 13, Illinois. *In Canada: Crane Packing Co., Ltd., 617 Parkdale Ave., N., Hamilton, Ont.*

*DuPont trademark

JOHN CRANE CRANE PACKING COMPANY 38 YEARS INDUSTRIAL PROGRESS





The above photo is an example of one out of thousands of Peerless Line Separator installations in Refining and Chemical plants throughout the world. This installation is doing an effective job of mist extraction in a petrochemical plant in Kentucky.

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able. For a book so replete with structural formulas and literature references it is remarkably free of errors. The volume will surely become an indispensable source of general information and guidance to chemists interested in the field of dyes and pigments.

One of the most valuable features of the monograph is its extensive references to the original literature. Postwar FIAT and BIOS reports on the German dye industry are covered particularly well. On the subject of literature references, it is somewhat disappointing that citation and critical evaluation of U. S. patent literature of recent years is not done very thoroughly, but this detracts little from the book's fundamental worth.

The authors have dealth with their subject under 12 main headings. Titles of the chapters are as follows: Benzene Intermediates, Naphthalene Intermediates, Azo Dyes, Azoic Dyes, Miscellaneous Dyes, Sulfur Dyes, Anthraquinone Dyes and Intermediates, Indigoid Dyes, Phthalocyanine Pigments, Phthalocyanine Dyes, Organic Pigments and Color and Chemical Constitution of Dyes. This breakdown appears adequate considering the relative, practical importance of the numerous classes of synthetic dyes that are known.

Phthalocyanine pigments and dyes are covered particularly well. Chapters devoted to these interesting chemical types contain much information not heretofore assembled in one place and therefore not readily available except to those intimately conversant with original literature sources.

The chapter on anthraquinone dyes and intermediates takes up a larger portion of the monograph, by far, than any other. This is in keeping, not only with the complexity of the subject, but also with the modern commercial importance of anthraquinone dyes. While the presentation is basically complete, it could perhaps have dealt with developments of the last several years somewhat more exhaustively than it does. One could gain the impression that technical progress in this area has been static

since about 1940 from a perusal of the literature references cited. This is, of course, not the case, though it must be admitted that relatively little of fundamental newness has been reported in recent years.

As implied by the title, this monograph concerns itself principally with the chemistry of synthetic dyes and pigments. Those seeking detailed information about applications and properties of dyes and pigments will find very little in this volume. Likewise, those desiring detailed knowledge of manufacturing procedures and engineering practices in the dye and pigment industry will not find it here. But for those who want to acquire a broad perspective of the chemistry of dyes and pigments, the present monograph can be highly recommended. Dr. Lubs and his associates at Du Pont have made a very worthwhile contribution to the chemical literature.

Recent Books Received

Analysis of Insecticides and Acaricides. By F. A. Gunther & R. C. Blinn. Interscience. $14.

Basic Lubrication Practice. By A. F. Brewer. Reinhold. $6.75.

Cellulose Nitrate. By F. D. Miles. Interscience. $7.

Chemistry of Synthetic Dyes and Pigments. Ed. by H. A. Lubs. Reinhold. $18.50.

Die Grundgesetze der Warmeubertragung. 3rd ed. By U. Grigull. Springer-Verlag. DM 37.50.

Handbook of Food and Agriculture. By F. C. Blanck. Reinhold. $12.50.

Information Processing Equipment. By M. P. Doss. Reinhold. $8.75.

Introduction to Chemistry. By H. L. Ritter. Wiley. $6.50.

Manganese. By A. H. Sully. Academic. $6.50.

Petrographic Mineralogy. By E. E. Wahlstrom. Wiley. $7.75.

Polarographic Techniques. By L. Meites. Interscience .$6.

Roger Adams Symposium. Wiley. $3.75.

Theoretical Structural Metallurgy. 2nd ed. By A. H. Cottrell. St. Martin's. $4.50.

Thermodynamics. By J. L. Finck. Bookman. $7.50.

Thermodynamics and Physics of Matter. By F. D. Rossini. Princeton. $15.

Vapor-Plating. By C. F. Powell, I. E. Campbell, B. W. Gonser. Wiley. $5.50.

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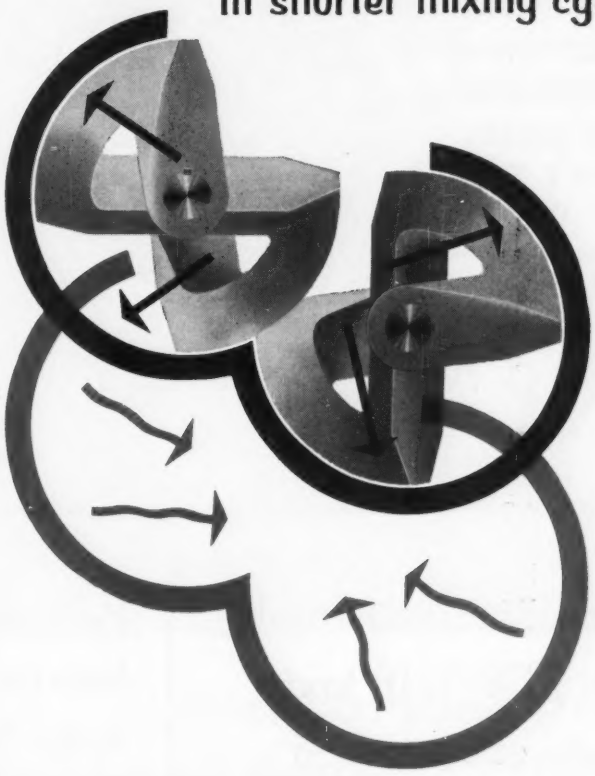

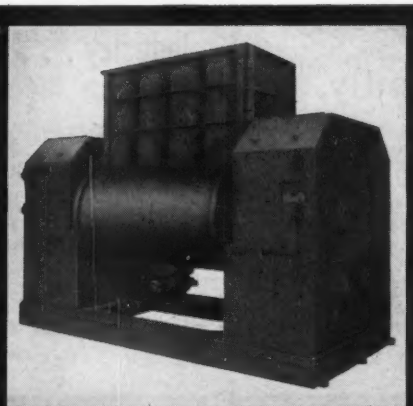

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THIS MONTH'S

Recent Books

Market Research

Marketing guide appraises the growing value and importance of marketing research in selling capital goods and industrial equipment, accessories and components. 48 pages.

"Marketing Research—A Guide for Capital Goods." Council for Technological Advancement, 120 South La Salle St., Chicago 3, Ill. $3.

Liquid Sugar

Comprehensive manual for industrial users of liquid sugar covers: production; distribution; its use in various food industries including typical formulations and proper equipment for specific liquid sugar systems; laboratory procedures. 205 pages.

"This Is Liquid Sugar." Refined Syrups & Sugars, Inc., Vark St., Yonkers, N. Y. $5.

Emulsions

For engineers and chemists in the cosmetic, food, paint and allied fields, pocket-sized book explains concisely the chemistry of dispersions and emulsions, emulsifying agents, surface activity and demulsification.

"Principles of Emulsion Technology." By Paul Becher. Colgate-Palmolive Co., 105 Hudson St., Jersey City 2, N. J.

Electrical Insulation

Latest ASTM methods of testing and specifications for electrical insulating materials used in machinery and devices ranging from the heaviest of generating equipment through the electrical appliance field to the lightest of electronic components. 660 pages.

"Standards on Electrical Insulating Materials (With Related Information)." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $5.50.

& Pamphlets

Petroleum Analysis

Fully described and illustrated with graphs and tables, here is a method for the determination of aliphatic sulfides in small samples of high molecular weight material such as a crude oil chromatographic fraction. 7 pages.

"Spectrophotometric Determination of Aliphatic Sulfides in Crude Petroleum Oils and Their Chromatographic Fractions." By Harry V. Drushel and James F. Miller. Mellon Institute of Industrial Research, 4400 Fifth Avenue, Pittsburgh 13, Pa.

Atomization

This summary of the current status of atomization and spray drying emphasizes those phases which, although fundamental, are not so familiar to the chemical engineer. Topics discussed include: principles of jet breakup, characteristics of various types of nozzles and atomizers, drop-size distribution. 122 pages.

"Atomization and Spray Drying." By W. R. Marshall, Jr. American Institute of Chemical Engineers, 25 West 45th St., New York 36, N. Y. $4.25.

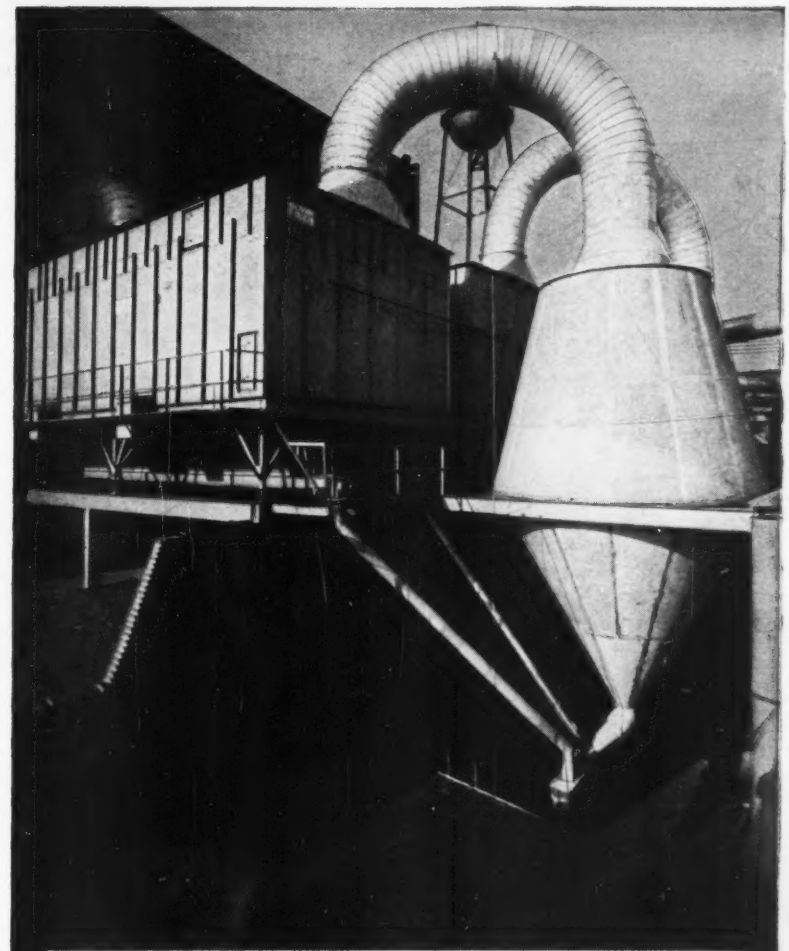
Corrosion Tables

These tables, the fourth part of a series dealing in alphabetic order with corrosive chemicals and their effect on materials of construction, covers the range from "butane" to "cavite.". 100 pages.

"Dechema - Werkstoff - Tabelle, Part IV." By E. Rabald and H. Bretschneider. The Dechema, Frankfurt a.M. W 13, Postfach, Germany. DM 30.

Research and Patents

Analysis of the organizational set-up of 104 nonprofit research and patent management agencies, their institutional affiliations, articles of incorporation and by-laws, objectives, operating procedures, research and patent policies, and



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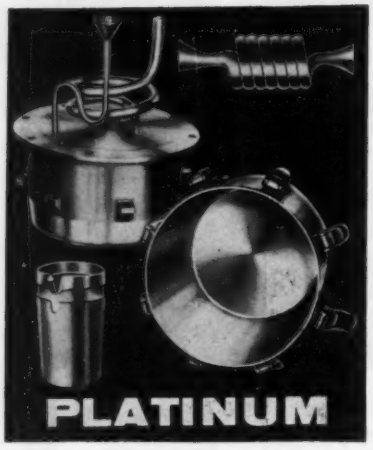

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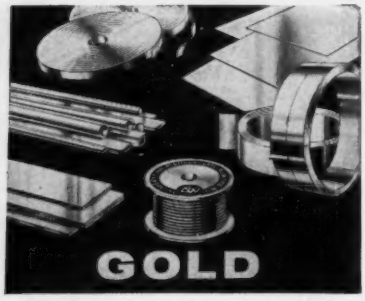

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PAMPHLETS . . .

experience with research and patent management problems. 150 pages.

"Nonprofit Research and Patent Management Organization." By Archie M. Palmer. Office of Patent Policy Survey, National Research Council, 2101 Constitution Ave., Washington 25, D. C. $3.

Cookery and Colloid Chemistry

Approaching cooking from the chemical and physical standpoint, this fourth edition discusses the effect of varying proportion of ingredients, the method of mixing, temperature of cooking, and the effects of storage and freezing on foods. 573 pages.

"Experimental Cookery." By Belle Lowe. John Wiley & Sons, 440 Fourth Ave., New York 16, N. Y. $7.50.

Proceedings

This record of the technical accomplishments of ASTM during 1954 includes reports from the society's 68 technical committees and 37 papers and discussions on a wide variety of subjects pertaining to research and testing of materials. 1400 pages.

"ASTM Proceedings for 1954." American Society for Testing Materials, 1916 Race St., Philadelphia 3, Pa. $12.

Clays

Summary of basic information on clays contained in 25 papers by authorities covering such fields as the geology, mineralogy, properties and identification of clays as well as the applications of clay technology in soil science, soid mechanics, the petroleum industry and ceramics. 326 pages.

"Clays and Clay Technology." Division of Mines, Ferry Bldg., San Francisco 11, Calif. $4.50.

Thermodynamics

For candidates preparing for the Professional Engineer's License, this study-aid, a second edition, contains a collection of selected

past examination problems and their solutions. Theory has been especially rewritten and recast for refresher purposes.

"Thermodynamics Refresher for Professional Engineer's License." By John D. Constance, 625 Hudson Terrace, Cliffside Park, N. J. $3.25.

Gasket and Grooves

The new American Standard for ring-joint gaskets and grooves covers: types and sizes, material, dimensions, tolerances, and finish, identification numbers, marking. 11 pages.

"Ring-Joint Gaskets and Grooves." American Society of Mechanical Engineers, 29 West 39th St., New York 18, N. Y. $1.

Solar Energy

Global directory of research on solar energy utilization. Each listing gives the title and address of the research group, names of principal researchers and brief description of their activities. Includes a 1,500-reference bibliography. 300 pages.

"Applied Solar Energy Research." By E. J. Burda. Assn. for Applied Solar Energy, Suite 204, Mayer-Heard Bldg., Phoenix, Ariz. $4.

To Venezuela

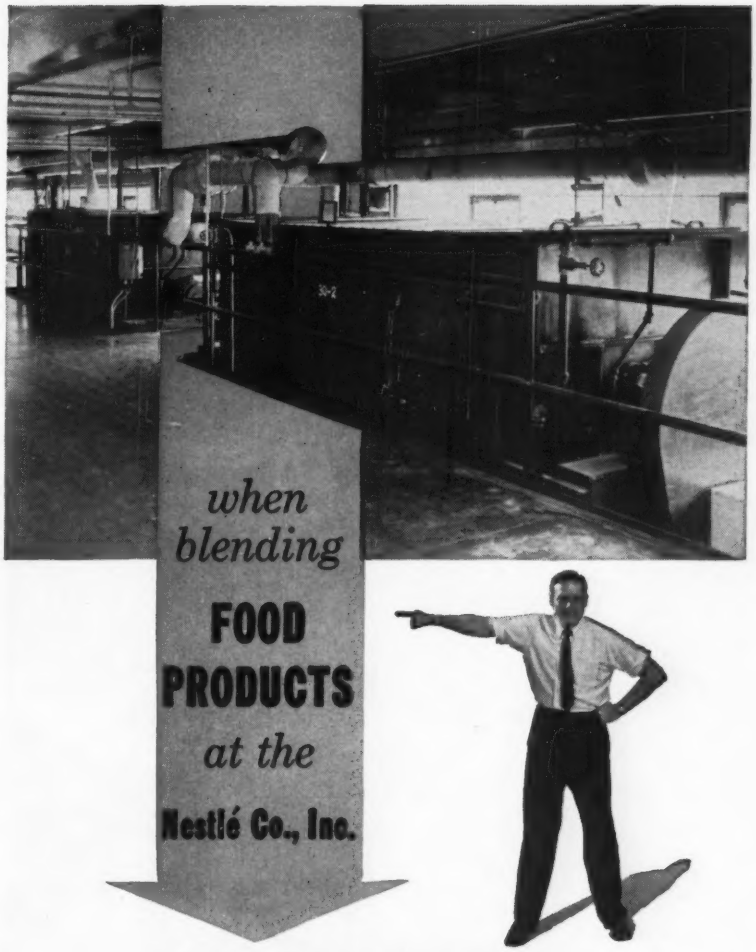
Report on the content, sources and dollar-volume of our exports to Venezuela which consist in large part of products of and for the chemical process industries. 80 pages.

"United States Exports to Venezuela." Creole Petroleum Corp., 350 Fifth Ave., New York 1, N. Y.

Commodities

For 94 basic commodities, statistical tables cover 1954 price records, production, consumption, supplies. 385 pages.

"1955 Commodity Yearbook." Commodity Research Bureau, 82 Beaver St., New York 5, N. Y. $12.



DAY JUMBO MIXERS . . . meet every requirement for maintaining a thorough blend of chocolate products under sanitary conditions at The Nestlé Company, Inc., Fulton, N. Y. For instance: seals may be furnished of sanitary construction requiring no packing, and of such simple design as to permit thorough cleaning in a matter of minutes between batches—(no more black specks working into product from stuffing boxes).

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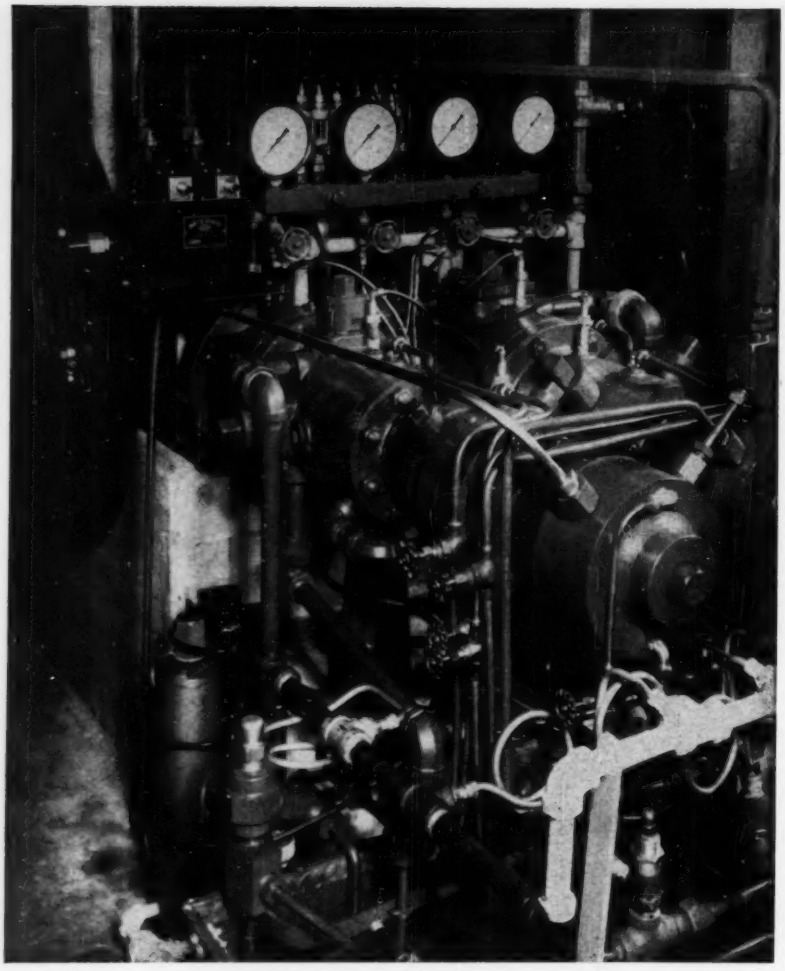
Western Canada: British Canadian Importers, Vancouver, British Columbia
Mexico: T. de la Pena e Hijos, S.A., Nazas 45-A, Mexico 5—D.F.



Six stage Norwalk compressor, used by a large university, compresses hydrogen to 25,000 pounds pressure

Horizontal duplex construction makes this compressor compact and sturdy. Frames with taper roller main bearings, reversible ring plate valves, force feed lubrication, generous intercooler coils are some of the features (common to all Norwalk compressors) that make for efficiency and long-term economy. Descriptive catalog forwarded promptly on request.

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THIS MONTH'S

Firms in

New Lines

Termomeccanica Italiana, La Spezia, Italy, has been licensed by Cooper-Bessemer Corp. to manufacture its GMXA and GMVA, V-angle engine-driven compressors as well as EM, FM and JM motor-driven compressors.

W. R. Grace & Co. has been licensed by Glidden Co. to produce and sell Glidden-formula paints in Argentina, Chile and Peru.

Continental Coatings Corp., Chicago, Ill., has been licensed by Armour Research Foundation to use the latter's patents in "Flame Spray Ceramics" in the service contract applicator field.

Davenport Machine and Foundry Co. has added a complete line of single and double atmospheric drum dryers (formerly manufactured by Yeast Processing Equipment Co.) to its dehydrating and drying equipment.

New Companies

The following new chemical companies have filed a charter of incorporation in Delaware: **American Exploration and Chemical Corp., Electro Chemical Corp., Cuban International Sulphur Corp., American International Pharmaceutical.**

Shawinigan Chemicals Ltd. has announced the formation of **Hedon Chemicals Ltd.** (England) to manufacture vinyl acetate.

Diamond Alkali Co. has announced the formation of **Insecticidas Diamond del Pacifico S.A. de C.V.** to manufacture and distribute agricultural chemicals in Mexico.

Food Machinery and Chemical Corp. and Tennessee Gas Transmission Co. have formed **Petro-**

the News

M. A. Gibbons

Tex Chemical Corp. to operate a 90,000-ton butadiene plant (Houston, Tex.) recently purchased by FMC from the government.

Farbwerke Hoechst, Deutsche Erdoel Co. and Mannesmann Steel Co. have formed a new plastics company, **Kohle-Oel Chemie** (coal-oil chemistry).

Formal approval of the Argentine government has been given to the formation of **Monsanto Argentina, S.A.I.C.,** wholly owned subsidiary of Monsanto Overseas S.A., and to the construction of a polystyrene plant near Buenos Aires.

Perkin-Elmer Corp. has announced the establishment of a new subsidiary, **Nuclear Magnetics Corp.**

Chas. Pfizer & Co., Inc. and Taito Co., Ltd. have announced formation of a new Japanese-American company, **Pfizer-Taito Co., Ltd.,** to manufacture Pfizer antibiotics and pharmaceuticals.

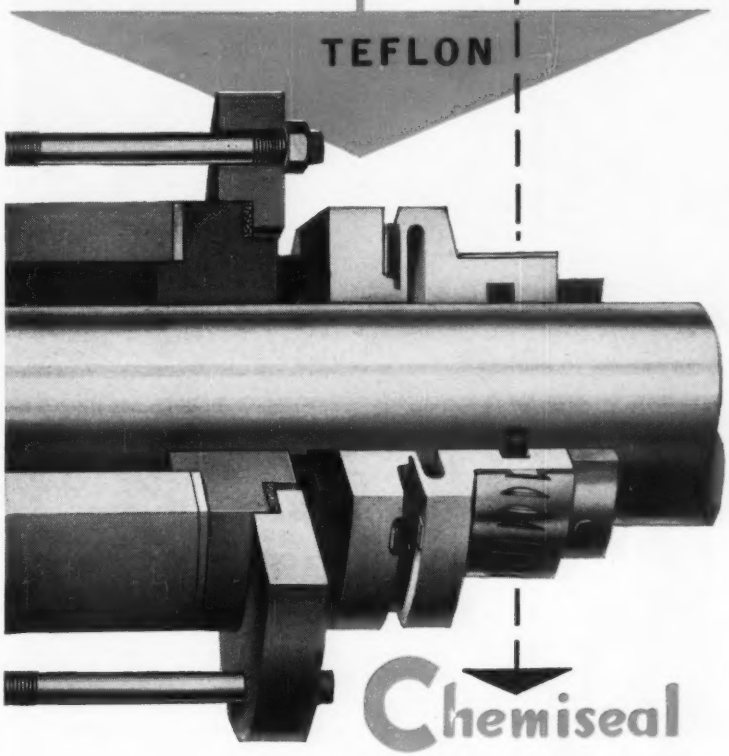
Resources Development Corp. has been formed by R. S. Foote, former head of the Geophysical Exploration Branch, Raw Materials Division, U. S. Atomic Energy Commission. The new company, with offices in New York City, will function as uranium and mining consultants and exploration specialists and will offer advisory services in radiation instrument development.

New Representatives

Foote Mineral Co. has appointed Fisons, Ltd. (England) and Hans Rahn and Co. (Switzerland) to represent the company's lithium chemical interest in the United Kingdom and Europe.

Bulkley, Dunton Processes, Inc., has appointed Backus & Spencer, Cleveland, O., to handle the

point of interest to **pump users...**



Chemiseal
MECHANICAL SEAL

Chemiseal Mechanical Seals last longer and give unsurpassed performance in a wide variety of chemical services.

Three years of actual field experience has proven it—handling acids, alcohols, alkalies, hydrocarbons; clear, abrasive and tarry materials.

Features: Seal rotates with shaft. Only bearing surface is between precision ground rotating and stationary faces. Combines chemically impervious TEFLON with a balanced bellows design.

Low friction load on shaft. Lower power cost.

No scoring of shafts. Even shafts already scored can be satisfactorily sealed.

Pressures at seal up to 100 psi at 75°C or 75 psi at 100°C.

Sizes from ⅜" to 2⅛". Maximum length 2¾". Other sizes for special applications.

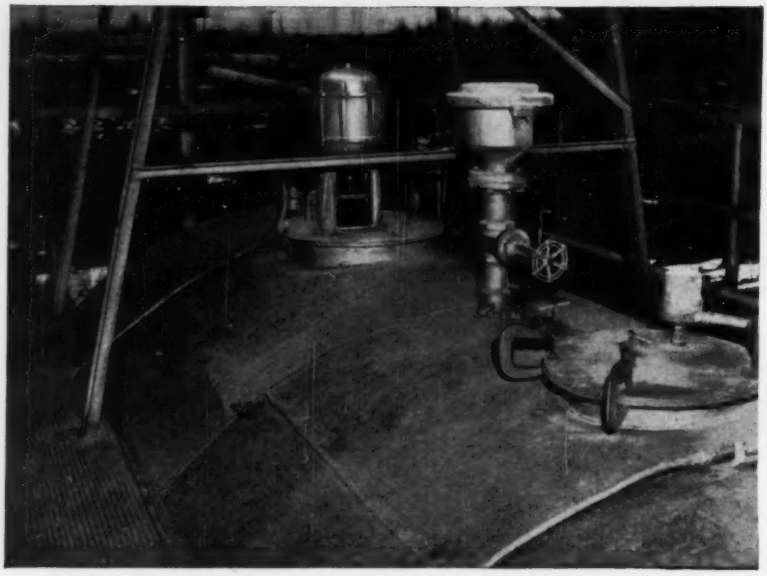
Write for Bulletin No. MS-954.

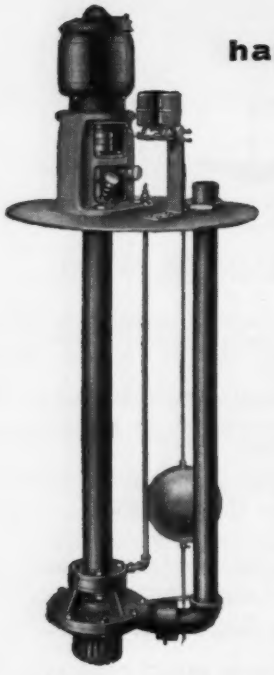
UNITED STATES GASKET COMPANY
CAMDEN 1, NEW JERSEY

USG

FABRICATORS OF FLUOROCARBONS & OTHER PLASTICS
Representatives in principal cities throughout the world

Built to take it... and Pump it, too!





Deming Sump Pump handles corrosive liquid for years without trouble

Transferring carbon disulphide from storage tank through a 350 pipe line to processing plant is the job of the Deming Vertical Sump Pump partially shown in the above view. A complete unit of this type of Deming Sump Pump is pictured at left. After 3 years of intermittent, daily service, the unit is still giving trouble-free service.

Deming Vertical Sump Pumps are available in sizes from 1 to 10-inch discharge with capacities ranging up to 3,000 G.P.M. and heads up to 140 feet. They can be furnished with electric motors up to 75 HP or for turbine drive. Duplex units are available. Write for free, illustrated Bulletin No. 4600-A which explains various types of Deming Sump Pumps.

THE DEMING COMPANY
525 Broadway • Salem, Ohio

DEMING PUMPS

75th ANNIVERSARY DEMING PUMPS 1880 • 1955

FIRMS . . .

company's complete line of equipment.

Eco Engineering Co. has appointed E. C. Roseberry & Co. as exclusive sales representative for Eco industrial pumps in Western New York State.

Graver Water Conditioning Co. has appointed Atlas-Misrock Co., Richmond, Va., as sales representative for the company's complete line of waste treatment equipment in the Delaware-Maryland-Virginia area.

Baird Chemical Corp., has been appointed U. S. sales agent for the sale of thiourea manufactured by **Miike Synthetic Industry Co., Ltd.**, Ohmuta, Japan.

New Locations

Hercules Powder Co. has established a new rubber chemicals sales office at Beaumont, Tex.

Administrative and sales office for **American Synthetic Rubber Corp.** has been opened in New York City.

Pfaudler Co. has moved its New York office to Hoboken, N. J., and its southwest regional office from Dallas to Houston, Tex.

Executive offices of **Servomechanisms, Inc.** have been moved from Garden City, L. I., to the company's Eastern (Westbury, N. Y.) and Western (Hawthorne, Calif.) Divisions.

Roots-Connersville Blower, Division of Dresser Industries, Inc., has established a Detroit sales office in Dearborn, Mich.

New Facilities

Gulf Oil Corp's 10,000-bbl.-per-day UOP Platforming unit has gone on stream at the company's Toledo, O., refinery.

Alaska Pine and Cellulose and Rayonier, Inc. will build the first sylvichemical manufacturing plant at Vancouver, B. C.

Kerr-McGee Oil Industries, Inc., Oklahoma City, has set up a wholly owned subsidiary to operate all refining, marketing and pipeline facilities, including those acquired from Deep Rock Oil Corp.

Arthur D. Little, Inc. has established a new management consulting service for industrial and financial groups interested in atomic energy.

In addition to its new laboratory at Linden, N. J., **Enjay Co., Inc.** will erect a building which will contain facilities for processing and testing materials and products made with Butyl rubber.

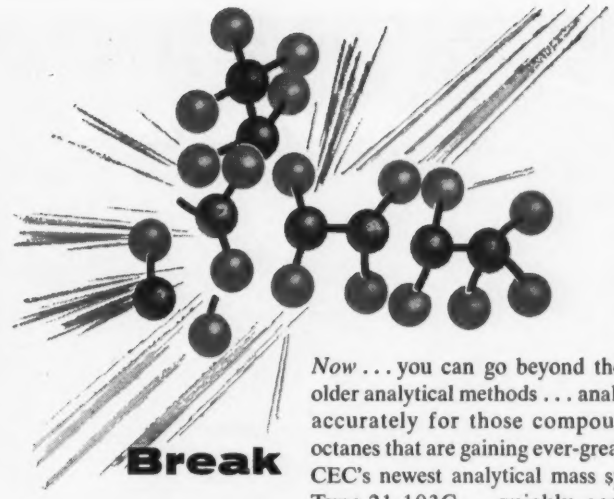
Permanente Cement Co. will construct a sixth rotary kiln at its Permanente, Calif., plant. The $4 million addition will increase production capacity 20%.

Midwest Research Institute has opened its modern research center at Kansas City, Mo.

Atlas Powder Co. has acquired Parke Thompson Associates, Kirkwood, Mo., for an undisclosed sum.

Pittsburgh Coke & Chemical Co. has acquired the agricultural chemicals program recently terminated by Ethyl Corp. Under the agreement, Pittsburgh Coke will continue the further evaluation, development and marketing of products that have been investigated in Ethyl's research program with what's said to be promising results.

Ammonia Chemical Corp. of Calif. will construct a $3.3 million anhydrous ammonia plant



Break through the octane barrier

Now . . . you can go beyond the limitations of older analytical methods . . . analyze quickly and accurately for those compounds above the octanes that are gaining ever-greater importance. CEC's newest analytical mass spectrometer . . . Type 21-103C . . . quickly, accurately determines mixture components at mass numbers as high as 700 . . . yet is equally at home in the field of gases and light liquids.

Only an hour or less is required for even complex mixture analyses (just minutes for key components) that once took weeks by fractional-distillation methods.

For fundamental petroleum and petrochemical research, for process development and for control, investigate the 21-103C. It makes an already important scientific tool—mass spectrometry—even more useful and versatile.

Complete details in our new brochure . . . send today for CEC 1800C-X15.

Ideal for exploratory analyses, the 21-103C registers every component of a sample . . . whether or not its presence is known.

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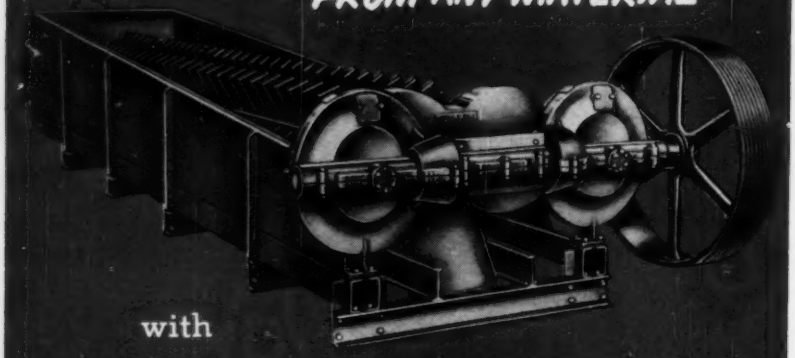
Sales and Service Offices Located in: Albuquerque, Atlanta, Boston, Buffalo, Chicago, Dallas, Detroit, New York, Pasadena, Philadelphia, San Francisco, Seattle, Washington, D. C.

Remove TOUGH CLAY, SOFT ROCK AND REFUSE FROM ANY MATERIAL



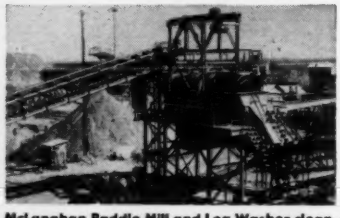
with

McLANAHAN LOG WASHERS

McLanahan Welded Steel Log Washers are smooth running, highly efficient machines for removing tough clays, soft rock and other materials from iron and manganese ores, barytes, zinc, ochre, peat, limestone, trap rock, sand and gravel, phosphate, gold and other ores. These machines remove high percentages of undesirable refuse—providing savings that more than pay for the installation in a very short time. A few of hundreds of applications are illustrated below.

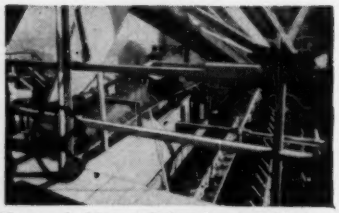
TYPICAL INSTALLATIONS OF McLANAHAN LOG WASHERS

Two pairs of 30' McLanahan Logs, used for cleaning sand and gravel in Virginia.



McLanahan Paddle Mill and Log Washer cleaning Texas limestone.

Write Today for Bulletin WLO-1253



New and old type McLanahan Log Washers used here remove clay from cement rock in Pennsylvania.

McLANAHAN & STONE CORPORATION

PIT, MINE AND QUARRY EQUIPMENT HEADQUARTERS SINCE 1835

254 Wall Street, Hollidaysburg, Pennsylvania

FIRMS . . .

in the Red Top district south of Merced, Calif.

Standard Oil Co. (Ind.) has awarded the contract for construction of a 6,000 bbl.-per-day Ultraformer in Mandan, N. D., to Ralph M. Parsons Co., Los Angeles.

Phillips Petroleum Co. will construct a 16,000 bbl.-per-day catalytic reformer unit at its Kansas City, Kan., refinery.

International Minerals & Chemical Corp. has completed negotiations to buy the TVA Godwin phosphate plant at Columbia, Tenn.

North American Aviation, Inc. has established a nuclear engineering and manufacturing division.

Consolidated Chemical Industries Inc. has put on stream two sludge acid regeneration units—one at Baytown, Tex., the other at Houston.

American Aniline & Extract Co., Inc. will construct a polyvinyl alcohol plant on a site adjacent to the Air Reduction plants at Calvert City, Ky.

Inland Steel Co. has announced a multi-million dollar construction program for its Indiana Harbor works. It will increase steel-making capacity by 200,000 tons a year, coke-making by 455,000 tons a year. Facilities for handling and storing coal, benzene, toluene, pyridine and ammonium sulfate will also be expanded.

Continental Copper and Steel Industries, Inc. has increased its activities in the field of steel, alloy and non-ferrous metal fabricating with the expansion of its research and design department.

Scientific Design Co., Inc. has been awarded contracts for the design and engineering of two overseas facilities. The first is

DURAMETALLIC *Packings*

Write today for FILE No. DMCE describing the complete line of Durametallic wear-free packings.

Product of

DURAMETALLIC CORP., KALAMAZOO, MICH.

Also manufacturers of rotary mechanical seals, oil pressure systems and packing tools.

SPRACO NOZZLES

Write for NOZZLE CATALOG *to*

SPRAY ENGINEERING CO.

115 CENTRAL STREET • SOMERVILLE 45, MASS.

CRUSH ROSINS

RESINS OR MALEIC ANHYDRIDE to Speed Processing

Discharge: ½" to 4" — adjustable
Up to 500 Pounds per Minute

CRUSHES ANY MATERIAL
Hard, Soft, Resinous, Waxlike, Brittle, Lumped, Caked, Granular.

FOR WAX, SPONGE IRON and
Rosin, DDT, Resins, Asphalt, Salts, Glass, Chocolate, Asbestos, etc.

DESIRABLE OUTPUT, FEW FINES
Positive Chopping Action. Feed and Discharge are Automatic.

RUGGED, HEAVY DUTY "SUPREME"
Many in Continuous Service for 35 Years . . . Results Guaranteed.

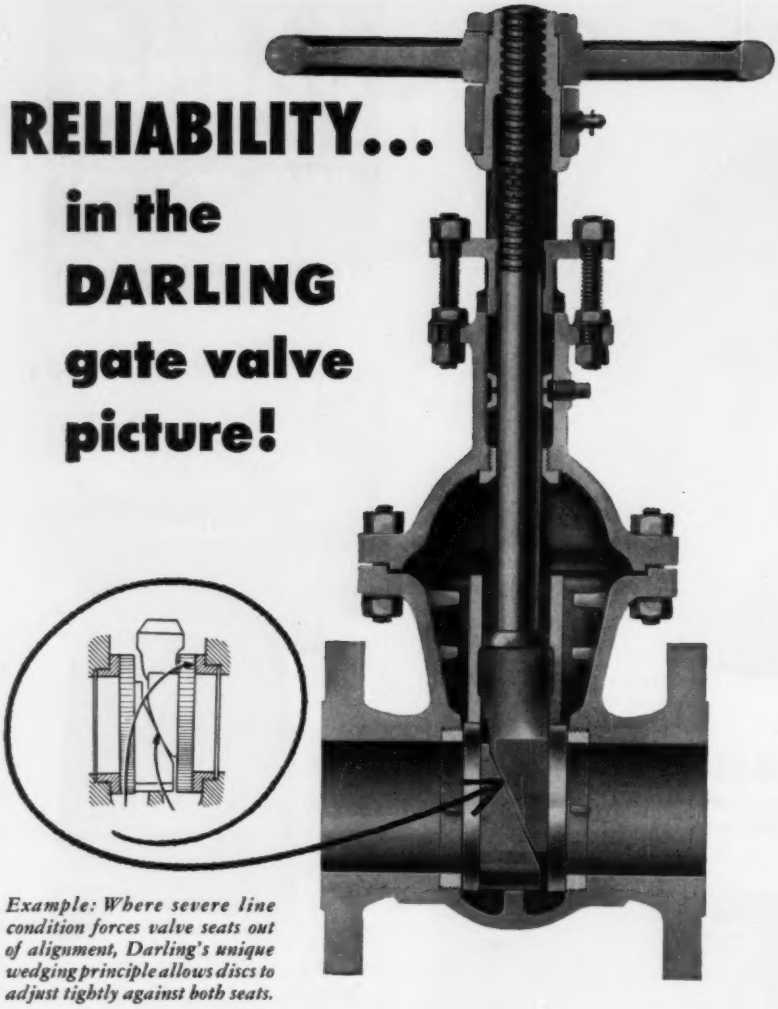
Free Test Run — Send 50 Pounds
Your Material. Crushed to Desired Size, Returned.

Since 1918—"Supreme" Standard Crushers
Range of Standard Models to meet your needs; from $425. Immediate Shipment.

SUPREME CRUSHERS

Mfd. by Franklin P. Miller & Son, Inc.
36 MEADOW ST., E. ORANGE 1, N. J.

RELIABILITY... in the DARLING gate valve picture!



Example: Where severe line condition forces valve seats out of alignment, Darling's unique wedging principle allows discs to adjust tightly against both seats.

THERE'S a sure way of minimizing valve leakage, down-time and a lot of costly maintenance for years on end. Try Darlings!

Darling's *fully revolving double disc parallel seat* principle does the trick . . . by distributing disc and seat wear uniformly, by compensating for valve body distortion, assuring tight closure under the most adverse conditions.

Darling gate valves are made in metals, types and sizes for most services . . . and for pressures up to 1500 pounds. Name your service and write for Bulletin No. 5003.

DARLING VALVE & MANUFACTURING CO.
Williamsport 3, Pa.
Manufactured in Canada by Sandilands Valve Manufacturing Co., Ltd., Galt 19, Ont.

DARLING TRADE DARLING MARK VALVES

FIRMS . . .

for ethylene oxide and ethylene glycol production units of a new petrochemicals plant to be built near Antwerp, Belgium. This plant will be operated by Societe Chimique des Derives du Petrole ("Petrochim"). The second contract is for a perchloroethylene plant to be operated by Pechiney in France.

American Radiator & Standard Sanitary Corp. has established a new division to coordinate all of the corporation's activities in the atomic energy field.

Petroleos Mexicanos, before the end of this year, expects to complete an $8.5 million absorption plant at Reynosa which will have a capacity of treating 300 million cu. ft. per day of natural gas from the Tamaulipas fields.

Goodyear Aircraft Corp. has begun construction of a new engineering and research building at Akron, Ohio.

Arthur Colton Co. has announced plans for a $500,000 expansion program for the production of tableting, filling, packaging and allied automation machinery for pharmaceutical, chemical processing, food processing, plastics and powdered metal industries.

Thunderbird Chemicals, Inc. has selected a site at Kyrene, Ariz., for a $13 million agricultural and industrial chemical plant.

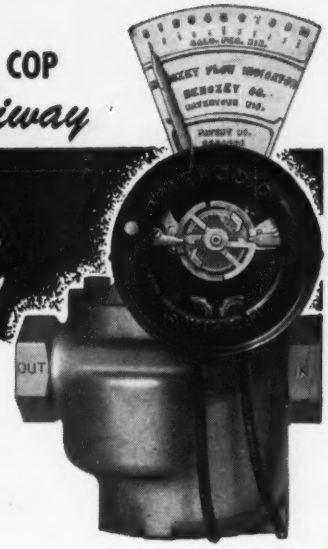
Oakite Products, Inc. has formed an export division to handle increasing demand from Latin American and overseas companies.

OPW Corp., manufacturers of valves, fittings and assemblies for handling hazardous liquids, has purchased Jordan Regulator Corp.

Central Farmers Fertilizer Co. has dropped plans to power the proposed elemental phosphorus furnace at Georgetown Canyon, Idaho, with energy from the

A FULL TIME TRAFFIC COP
on your fluid hiway

HENSZEY
FLOW METERS
with Alarm Control



RINGS A BELL—LIGHTS A LIGHT or ACTIVATES a MOTORIZED VALVE

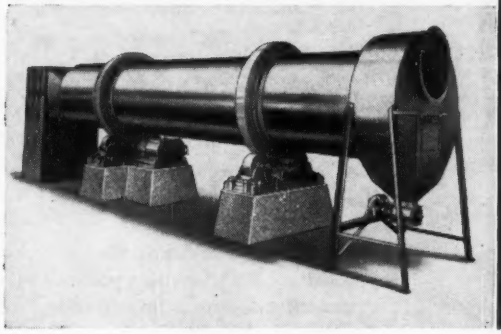
There are only three moving parts in the HENSZEY FLOW METER — no breakdown due to complicated gears and mechanism. Goes right in the line — no additional supports. Indicates flow within 3% absolute accuracy, even with pulsating flow. Send for bulletin.

SOUND ALARM AT HIGH OR LOW FLOW!

Easy to set on face of switch — unaffected by dust, dirt or corrosion — no pitting or sticking.

HENSZEY COMPANY
DEPT. E8 WATERTOWN, WISCONSIN

DAVENPORT ROTARY
HOT AIR DRYER 3'6" dia. x 20'0" long



DAVENPORT
PRESSING – DRYING and COOLING Equipment
Continuous DeWatering Presses
ROTARY DRYERS Steam Tube, Hot Air and Direct Fire
Atmospheric DRUM DRYERS
ROTARY COOLERS Water and Air

Operating on Whey Powder

Davenport Stainless Steel Rotary Hot Air Dryer drying whey powder in one of the largest Swiss Cheese plants in the United States.

Let our engineers consult with you on your Pressing, Drying, and Cooling problems. Send for complete Catalog "A" or for quick reference, consult your *Chemical Engineering Catalog*, 1954 or 1955.

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DAVENPORT, IOWA U. S. A.

Efficient—Economical—

Tennessee's
LIQUID
Sulfur Dioxide

SULFUR-DIOXIDE
HIGHEST QUALITY
SO_2

This versatile chemical is particularly recommended for its properties as a reducing, neutralizing and bleaching agent, preservative, antichlor and pH control.

Tennessee's Liquid Sulfur-Dioxide is practically 100% pure.

In many fields of industry this chemical of hundreds of uses can be very efficiently and economically used in various production processes. Perhaps Tennessee's Liquid Sulfur-Dioxide can be utilized to great advantage in your processing.

We would be pleased to discuss this versatile chemical with you.

AVAILABLE IN:
Cylinders, Ton Drums, Tank Trucks and Tank Cars

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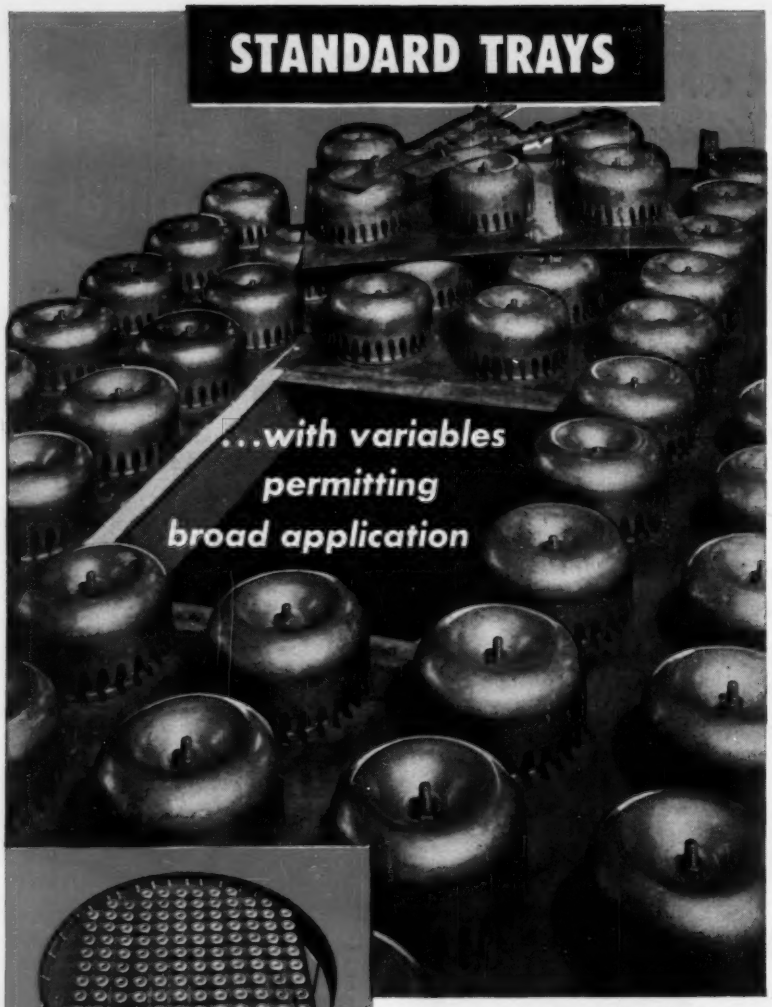
617-629 Grant Building, Atlanta, Ga.

STANDARD TRAYS



Designs of our Standard Trays are available for high vapor loads, high liquid loads, or average types of operations.

Flexibility in design comes from these three principal variables:

***1* CAP SIZE**

***2* CAP SPACING**

***3* SKIRT CLEARANCE**

These trays are self-supporting on column tray rings up to 10 foot column diameters, thus eliminating the need for extra perlins or beams on such sizes. They are available in all diameters used in practice and in all commercial metals.

Engineering and Manufacturing
Process Equipment of Our Design to Solve Your Problem

Inquiries should include process information in order that we may offer the proper tray design for each process. With other types of trays also available, we can offer an exceptionally wide selection. You will get the best tray for your requirements.

BADGER MANUFACTURING COMPANY

230 BENT STREET, CAMBRIDGE 41, MASS., 60 EAST 42nd STREET, NEW YORK 17, N. Y.

FIRMS . . .

proposed high-level Hell's Canyon Dam on Snake River.

Kawecki Chemical Co., Boyertown, Pa., is studying the feasibility of a native selenium ore processing plant in the Lysite area near Shoshoni, Wyo.

Flanders Mining Co., Grand Junction, Colo. has acquired a 5-year lease on 15,577 acres of state land in the potash area of Eddy County, N. M.

Tennessee Products & Chemical Corp. has expanded its operation to include production of ferrochrome.

National Aniline Division, Allied Chemical & Dye Corp., has opened its new research and engineering center at its Buffalo, N. Y. plant.

Spokane Gas & Fuel Co. will start its $5 million program of rehabilation and expansion late this fall, as a prelude to the arrival of natural gas expected by July 1956.

Texas Portland Cement Co. will construct a $2.5 million portland cement plant at Echo, six miles north of Orange, Tex.

Big West Oil Co. has announced award of construction contracts for a 1,000 bbl.-per-day catalytic reforming plant at its refinery in Kevin, Mont. License agreements and construction contracts have been given to Universal Oil Products Co. and its subsidiary, Procon.

Crown Zellerbach Corp. has announced plans for construction of a 22-story, multi-million dol-

OLDBURY
1896 ®

Tomorrow is here . . .

Many of the chemicals we make today were the "tomorrows" of times past. Many of the uses for these chemicals, too, were unthought of at the time these were first made available. Many of the *users,* too, are industries that were unknown and unthought of a few decades ago.

Tomorrow's "tomorrows" are already part of everything we do and make. And what we know . . . or are learning . . . we are ready to share among all users and potential users of Oldbury products.

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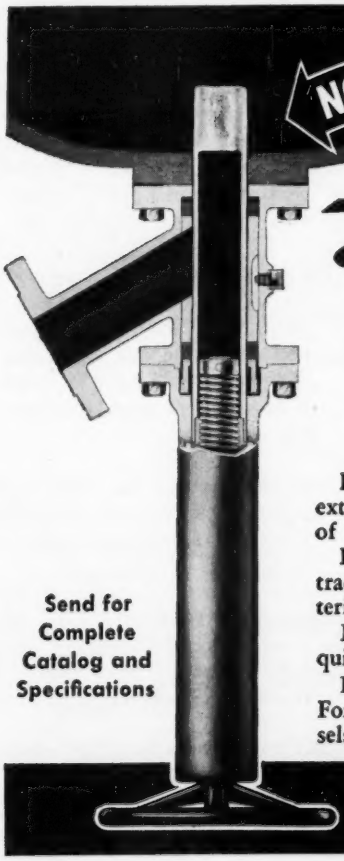

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RAM TYPE
Drain Valves
The Only Drain Valve That Cannot Clog Up!

In the closed position the piston or ram extends up into the tank, preventing plugging of the outlet.

In the open position with piston fully retracted, there is no resistance to flow of materials drained from the tank.

Made in any cast metal to meet your requirements.

Designed for bolting to existing flanges. For special adaptations and for jacketed vessels, adaptor pads are available.

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SCRUBBING CORROSIVE GASES ?

Are your scrubbing nozzles as efficient as you think they could be? Do they resist the corrosion or wear conditions satisfactorily —produce the breakup and distribution you would like?

Outline your spray problem for us—if your liquid can be sprayed with direct pressure at all—Monarch can furnish the nozzles.

NOZZLES FOR:

- OIL ATOMIZING
- HUMIDIFYING
- AIR WASHING
- DESUPERHEATING
- SPRAY PONDS
- MILK POWDERING
- ACID CHAMBERS
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Write for Catalogs 6-A and 6-C

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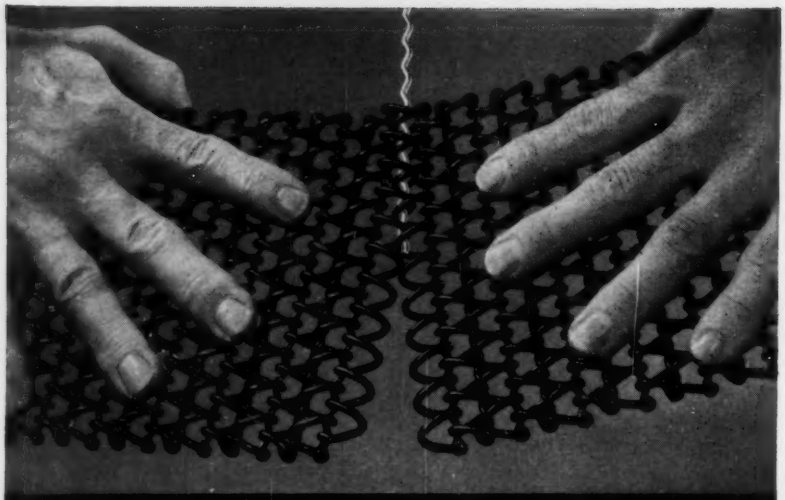


NO SEAMS!

Means continuous production with no tear, less wear

on *Cambridge*

WOVEN WIRE CONVEYOR BELTS

No seams to tear! No lacers to wear! No fasteners to cut the belt! There are no weak spots in Cambridge belts because the ends are joined the same way the belt is made . . . you're assured of smooth, trouble-free operation.

Whether you're designing machines for your own operation or for resale, you can eliminate batch handling, cut costs, provide continuous production at controlled rates of speed with moving woven wire belts.

All-metal Cambridge Woven Wire Conveyor Belts are corrosion resistant and impervious to damage from constant operation at temperatures from sub-zero to 2100°F. Open mesh construction lets process atmospheres circulate freely for uniform cooling, heating, drying . . . provides flash drainage of solutions, rapid washing, quenching, cleaning, draining.

No matter how you look at it, CAMBRIDGE Woven Wire Conveyor Belts are invaluable aids to AUTOMATION . . . help beat your biggest competition, COST. They are made in any size, mesh or weave, from any metal or alloy. Special raised edges or cross-mounted flights are available to hold your product during movement.

Call in your Cambridge Field Engineer to discuss how you can cut ultimate costs by continuous operation. You can rely on his advice. Write direct or look under "Belting, Mechanical" in your classified telephone book.

BAGGED CEMENT . . . Smooth belt won't tear package. Spillage sifts through open mesh to be salvaged.

ASK FOR FREE 130-PAGE REFERENCE MANUAL illustrating and describing woven wire conveyor belts. Gives mesh specifications, design information and metallurgical data.

The Cambridge Wire Cloth Co.

WIRE CLOTH | METAL CONVEYOR BELTS | SPECIAL METAL FABRICATIONS

Department G, Cambridge 8, Maryland

OFFICES IN PRINCIPAL INDUSTRIAL CITIES

FIRMS . . .

lar headquarters office building in downtown San Francisco.

B. F. Goodrich Co. has joined with Peruvian interests to establish a new tire and rubber company in that country. A new plant, designed by Goodrich engineers, is under construction near Lima.

B. F. Goodrich Chemical Co. has announced plans for a $2.5 million expansion at its Louisville, Ky., plant. The expansion program is closely allied with the company's new $8.5 million acrylonitrile plant now being completed at Calvert City, Ky.

St. Regis Paper Co. has announced its acquisition of all of the common stock of Pollock Paper Corp., Dallas, Tex., as a result of an offer of exchange made by St. Regis.

Bankline Oil Co. plans to build a coking plant and catalytic reformer and convert an existing (unused) hydrofluoric acid alkylation unit into a sulphuric acid alkylation plant as improvements to its Bakersfield, Calif., refinery.

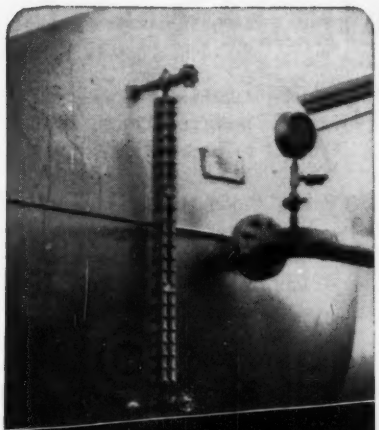
Plains Oil Mills, Inc., is starting construction of a plant to process safflower seed at Sidney, Neb.

Freeport Sulphur Co. announced the closing of Hoskins Mound sulfur mine due to the exhaustion of the deposit. The company plans to develop a newly discovered deposit at Lake Pelto, La.

National Gypsum Co. will build a gypsum wallboard and plaster plant in Burlington County, N. J.

General Refractories Co. announced plans to put its new high-quality fire brick plant in operation at Lehi, Utah.

McGraw-Hydrocarbon, Inc., a joint venture of F. H. McGraw & Co. and Hydrocarbon Research, Inc., has been awarded a contract for



You can
LICK YOUR PROBLEM
easier when you
Go to JERGUSON
for Liquid Level
Gages and Valves

Here's why:

Complete Line of Armored Gages and Valves

Complete line of Armored Gages and Valves for handling hazardous or valuable liquids without fear of leakage or breakage.

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Gages and Valves made in stainless, monel, nickel, hastelloy, etc. Linings in rubber, neoprene, lead, Kel-F and other materials.

Other Variations to Meet Your Needs

Variety of close hookups; end, side or back connections. Valves available with quick-closing, double seating or throttling stem; vacuum tailpiece; connections flanged, socket welding, solid shank or spherical union. New design valves for instrument connection and sampling service.

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Specialists in level indication where the service is hazardous, using special materials and construction, for any pressure. Progress based on working with men in the field. Jerguson engineers are ready and willing to help you with your problem . . . to develop exactly the right equipment for you.

Ask Jerguson to help on your problem, or write for General Catalog.

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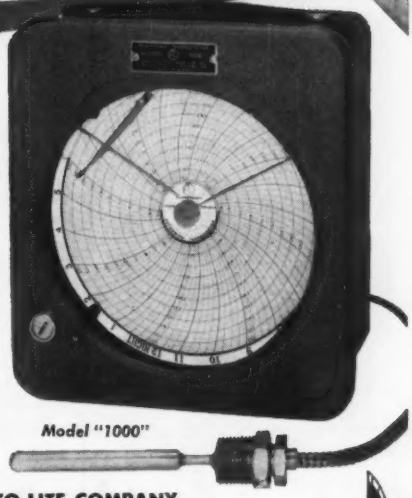
TEMPERATURE RECORDING...

Newly designed, Model "1000" Auto-Lite Recorder gives permanent proof of temperature behavior. • 6" clear reading chart; various standard ranges from minus 40°F. to plus 550°F. • 3 standard types; choice of 24-hr. or 7-day cycle. • Electric or mechanical chart drive. • With capillary tubing for remote reading. Priced from $49.50.

Send for new catalog describing many styles of Auto-Lite temperature Recorders and Indicators.

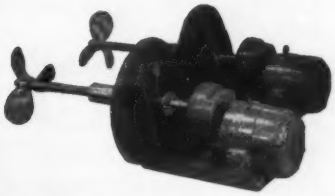


Model "1000"

THE ELECTRIC AUTO-LITE COMPANY
INSTRUMENT AND GAUGE DIVISION
TOLEDO 1, OHIO
NEW YORK • CHICAGO • SARNIA, ONTARIO

TEMPERATURE RECORDERS

if MIXING *is the problem ...*



ALSOP has the answer

For over 30 years, processing men have relied on the consistent high standard of Alsop Mixers—and the technical service of Alsop engineers to help solve their mixing problems.

If your process involves mixing, blending, suspending or dissolving it will pay you to invest in an Alsop Mixer. Available in portable or stationary models in a wide range of powers, speeds and propeller combinations for efficient, economical operation.

Write for complete information giving details of liquids and quantities to be handled.

ALSOP
ENGINEERING CORPORATION
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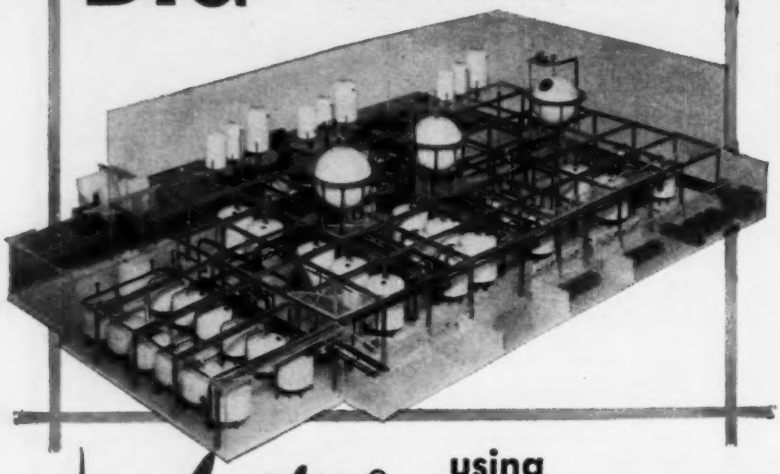
It pays to buy **- ALSOP**
FILTERS - MIXERS - PUMPS & TANKS

Model of

BIG DEMINERALIZER EFFICIENCY



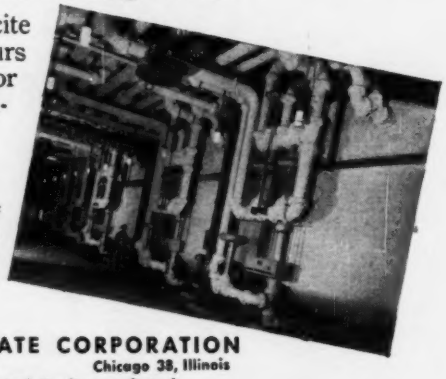
Nalcite® (DOWEX*) using ION EXCHANGE RESINS

BUILDING and operating a giant demineralization plant, like the one shown in model form above, are most impressive achievements. Unseen, yet vital, are the materials for which the whole plant is designed: the ion exchange materials used.

In this demineralizer, as in many other installations, Nalcite Ion Exchange Resins do the job efficiently . . . with both high capacity performance and outstanding resistance to attrition losses.

Whether your demineralization needs call for a pint an hour or thousands of gallons per minute—make sure the chemicals that do the job are Nalcite Ion Exchange Resins.

Technical data on Nalcite Ion Exchangers are yours for the asking. Write for this valuable information today.



The model grows up. Section of demineralizer plant modeled above—one of world's largest—showing some of automatic control features.

NATIONAL ALUMINATE CORPORATION
6236 West 66th Place • Chicago 38, Illinois
In Canada: Alchem Limited, Burlington, Ontario
*Reg. Trademark of The Dow Chemical Company.

Nalco

When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology.

FIRMS . . .

the design and construction of a $25-million chemical fertilizer plant to be built in Korea.

Pabco Products, Inc. has broken ground for its eighth manufacturing plant at Newark, Calif. The plant will turn out gypsum wallboard, lath and sheathing.

Shawinigan Resins Corp.'s polyvinyl resin sales will be handled directly through the company's newly formed marketing department.

Metrotype Corp., manufacturer of data reduction equipment, has been purchased outright by Hays Corp., Michigan City, Ind.

Richfield Oil Corp. has started building its first catalytic reformer—a Sinclair-designed 17,000-bbl.-per-day Baker-Sinclair platinum catalyst unit—at its Watson, Calif., refinery.

Swedish Cellulose Corp. plans to build a new newsprint plant with a capacity of 140,000 tons a year at Sundsvall.

Northern Chemical Industries, Inc. is building a new 100-ton-per-day sulfuric acid plant (Monsanto contact type).

Pure Oil Co. will install a 15,000-bbl.-per-day Ultraformer and a 20,000-bbl.-per-day feed preparation unit at its Smiths Bluff refinery near Beaumont, Tex.

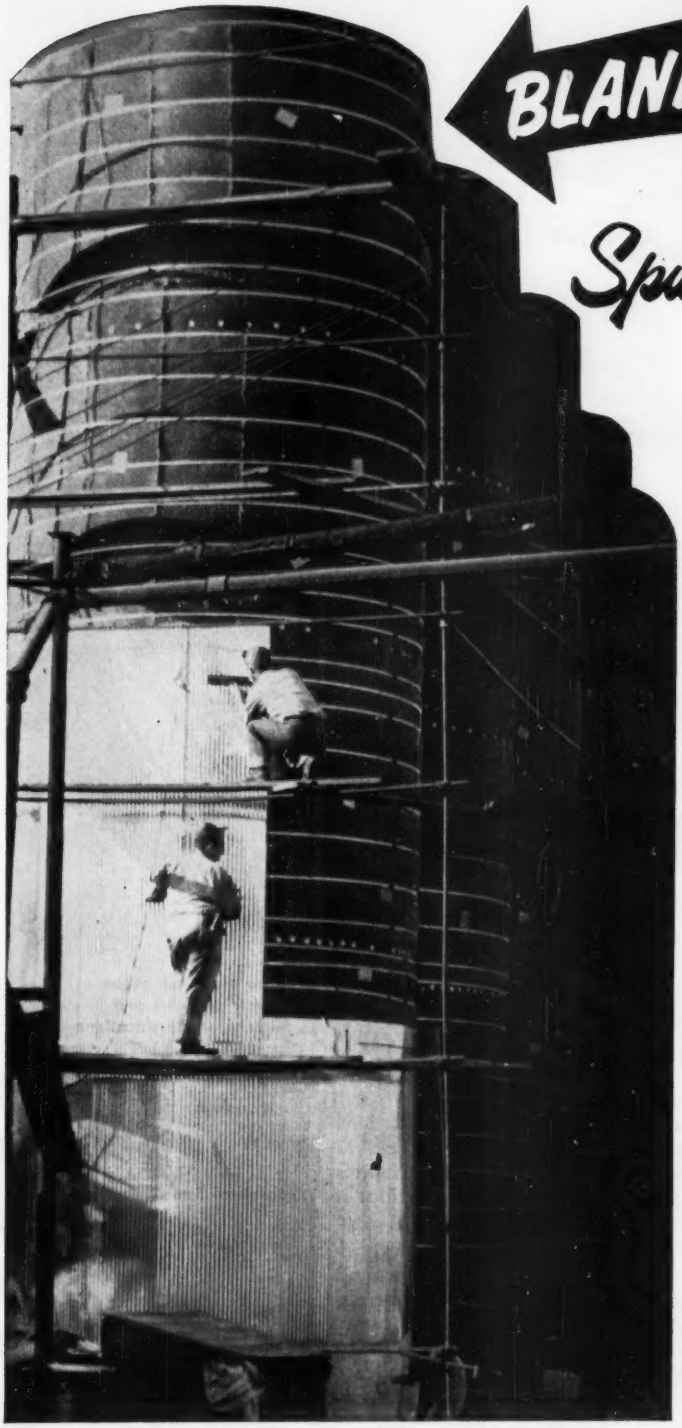
Mission Manufacturing Co., producer of fluid end slush pump parts, will soon open a new manufacturing plant at Belfast, Northern Ireland.

Buckeye Soda Co. will soon be liquidated and its administrative operations will be absorbed by Diamond Alkali Co.

Catalytic Construction Co. has completed a 6,000 bbl.-per-day Houdriformer catalytic reforming unit at Catlettsburg, Ky., for Ashland Oil and Refining Co.

NOW... a better insulating

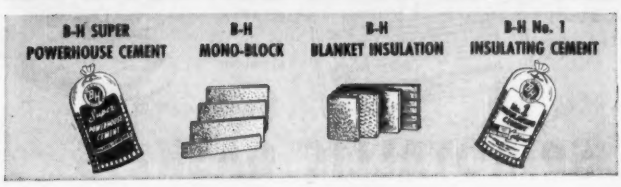
BLANKET made with BALDWIN-HILL Spun MINERAL WOOL



Baldwin-Hill Insulating Blankets now have lower density but greater strength due to the longer, finer mineral wool fibers produced by the NEW B-H spinning process. With the lighter weight, B-H Blankets are applied with amazing ease and speed.

HOT or COLD
IT NEEDS INSULATION
This Mineral Wool Insulation conforms to COMMERCIAL STANDARD CS-117-49 as issued by U.S. DEPARTMENT of COMMERCE
In cooperation with INDUSTRIAL MINERAL FIBER INSTITUTE, INC.
CERTIFIED BY MANUFACTURER No. 100

Storage Tanks insulated with 1½" thick B-H Blankets having 1" wire mesh on one side; expanded metal lath on other side.



BALDWIN-HILL COMPANY

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Kalamazoo, Mich. Huntington, Ind. Temple, Texas

Painting, courtesy Power Magazine

New J-M Color Code identifies metal in Spirotallic® Gaskets

Most engineers know that Spirotallic Gaskets maintain a perfect seal despite extreme fluctuation in fluid pressure and flange compression. Consequently, these gaskets are used in a wide range of service conditions which include high temperatures, elevated pressures and active corrosives. To withstand these conditions, Spirotallic Gaskets employ a variety of corrosion-resistant alloys.

Because so many of these metals look alike, only expensive tests or costly experience with the gasket could determine the gasket metal used, once its identifying tag was lost. Now the color patch on the centering guide tells the metal employed and saves time, trouble and expense. This new method of identification also makes it easier for storekeepers and mechanics who handle the gasket. In addition, it simplifies inventories.

Spirotallic Gaskets hold their seal because they are made of spirally wound interlocking plies of asbestos and springlike metal strip. These gaskets compress easily with light bolting. For catalog PK-35A and copy of color code card write Johns-Manville, Box 60, New York 16, N. Y. In Canada, Port Credit, Ont.

Here are seven of the metals available and their color identifications

Zinc-coated steel—white

Type 304 Stainless—yellow

Type 316 Stainless—green

Type 347 Stainless—blue

Monel—orange

Copper—brown

Aluminum—aluminum

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Johns-Manville SPIROTALLIC GASKETS

Over 6 Million Tons of
SULFURIC ACID*

produced annually in plants designed and built by CHEMICO

More than 165 Chemico H_2SO_4 plants are today in operation all over the world

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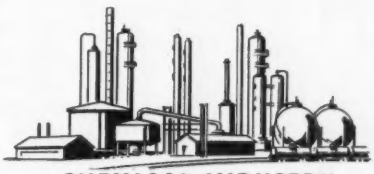
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*Chemico-designed plants now under construction will have an additional annual capacity of 500,000 tons of sulfuric acid by the end of 1955.

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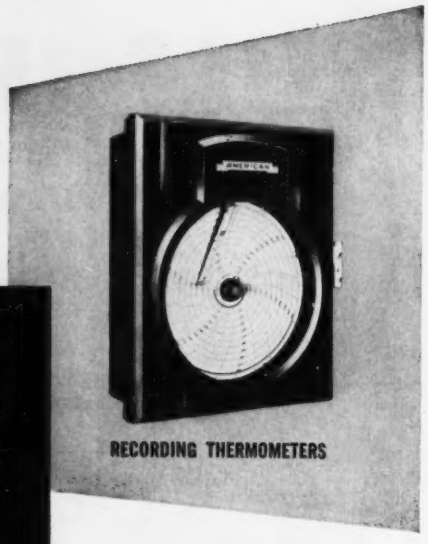
DIAL THERMOMETERS



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SPECIFY AMERICAN THERMOMETERS!

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Whether you need industrial glass thermometers, dial types, or recorders, the complete American line provides for practically every application. Depending on instrument type and requirements, temperature ranges available are: minus 80° F. to plus 1150° F. Types of actuation include: mercury, vapor pressure, gas and bi-metal.

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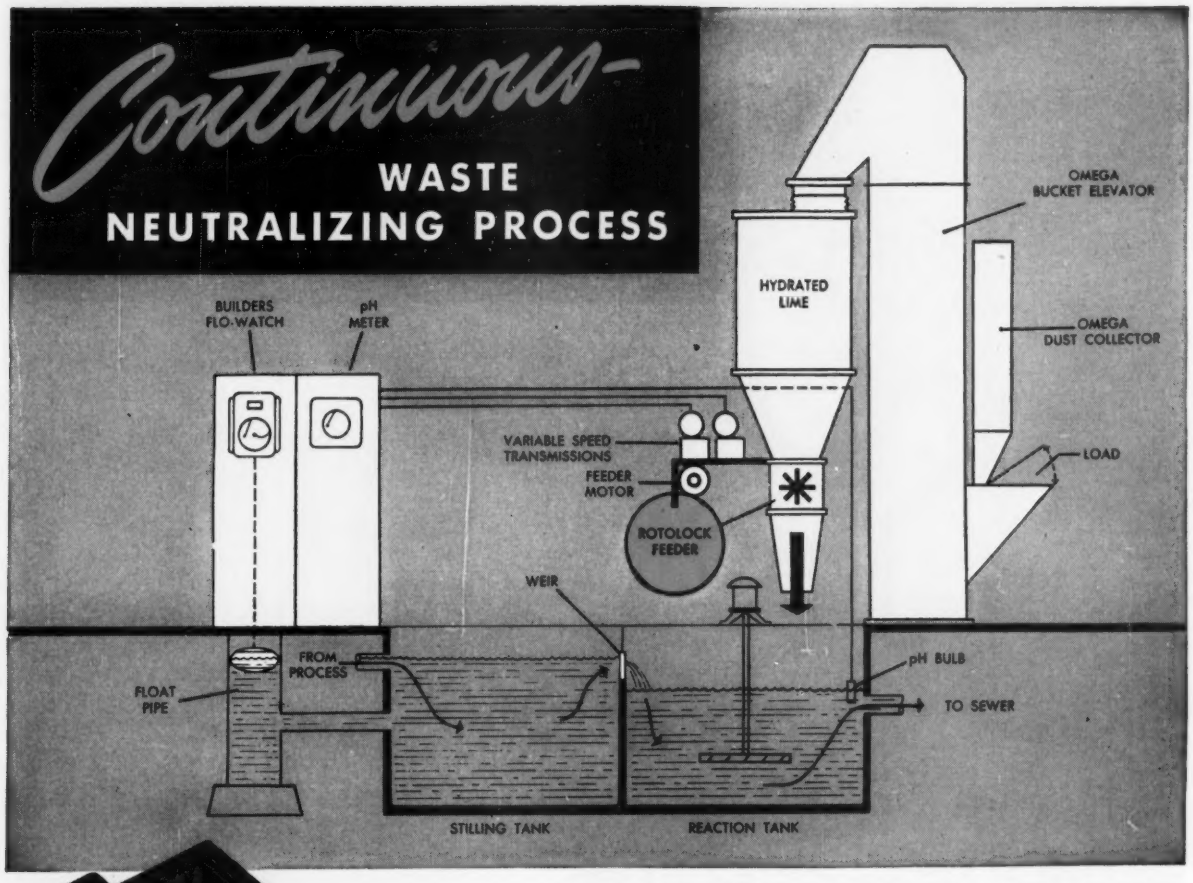
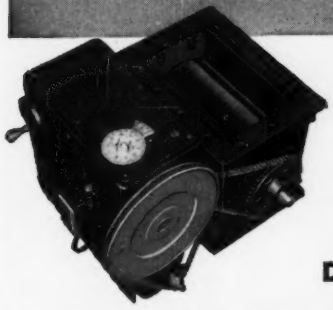
Continuous- WASTE NEUTRALIZING PROCESS





OMEGA ROTOLOCK DOES THE JOB

Omega Rotolock—a rotating vane feeder—feeds hydrated lime into the reaction tank in response to the flow of acid waste (measured by a Builders Flo-Watch Instrument) and to the degree of neutralization (measured by a pH meter).

The Rotolock is a volumetric feeder of simple design and rugged construction, easily adapted to installations requiring proportional pacing by auxiliary meters. The Feeder, powered by a 1/4 HP motor, has a 100 to 1 feed range. Two models of Omega Rotolock Feeders are available, covering the complete range of feeds from 7.2 to 300 cu. ft. per hr.

Here's how Omega helped a customer's engineer solve a waste treatment problem for one of the nation's leading manufacturers of electrical and electronic equipment. This acid waste neutralizing "equipment package" comprises feeding, controlling, and metering units required for continuous, accurate operation . . . Omega bucket elevator, dust collector, storage hopper, Rotolock Feeder, and Builders Instruments and Control Panel. Performance of this "package" under actual job conditions has proven again that it pays to take advantage of Omega's engineering and manufacturing experience, when you need continuous proportioning equipment.

Hundreds of today's processing and production problems are being solved by Omega "packages" — for waste treatment, for proportioning two or more solids, for proportioning liquids and solids. Send for Bulletin 45-H8 describing Omega Rotolock Volumetric Feeders, or tell us about your waste treatment or process problems. Omega Machine Co., **369** Harris Ave., Providence 1, R. I.

OMEGA *THE LAST WORD IN* **FEEDERS**

DIVISION OF B-I-F INDUSTRIES, INC.

BUILDERS IRON FOUNDRY • PROPORTIONEERS, INC. • BUILDERS-PROVIDENCE, INC.

B-I-F METERS FEEDERS CONTROLS

For any kind of chemical construction . . .

you can count on KOPPERS!

In the chemical industry, only in rare instances do the results of research justify the immediate construction of a full-scale chemical plant. Therefore, Koppers builds development plants as well as large chemical plants.

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Our Engineering and Construction Division can handle your smallest or largest construction jobs. Whether you are interested in producing test-tube or tank-car quantities of chemicals, just call on Koppers. Your inquiry is invited.

KOPPERS®

KOPPERS COMPANY, INC.
Engineering and Construction Division
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VARITROL® automatic variable speed

SAVES MANPOWER

IMPROVES PRODUCT

INCREASES OUTPUT

Now, by controlling speed with the Varitrol as a component of the U. S. Varidrive motor, speeds can be *automatically* changed in response to a signal *without* human attention for precision-control operations. At right is shown just one of the many ways in which Varitrol automatic control of U. S. Varidrive motors can be used for automatic production control. An educational booklet, edited by variable speed engineers, illustrates with applications this method of greater production of more goods and services at lower cost and astounding man-hour savings. Write today for your complimentary copy.

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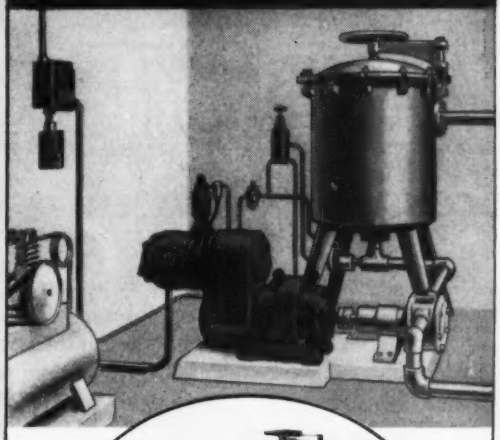

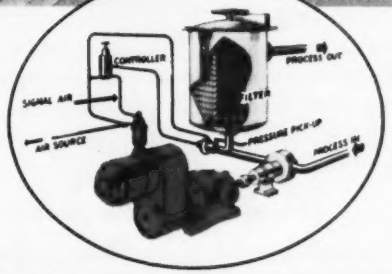

A Varidrive-operated pump runs at high speed with clean filter to obtain maximum flow. As filter clogs, pressure pick-up signals Varidrive which gradually slows down to limit filter back-pressure. When filter is clean, speed automatically increases.

U. S. VARIDRIVE WITH VARITROL®

Send for informative full-color booklet on Automatic Speed Control

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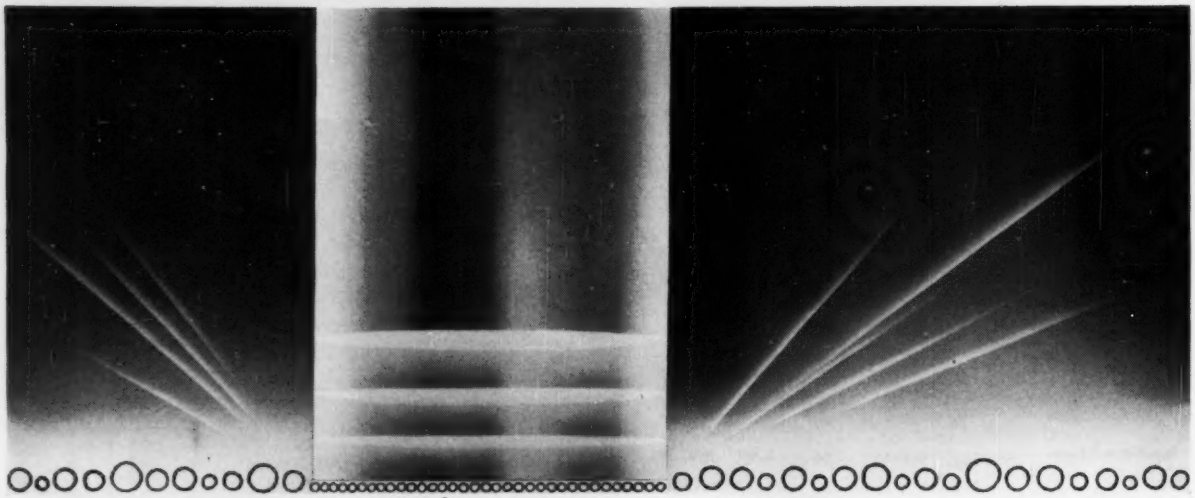

IMPACT Improves Products—Cuts Processing Costs in a Gaulin Homogenizer

Today, a Gaulin Homogenizer has many important uses besides making stable emulsions and dispersions. By forcing products at tremendous velocity through a microscopic orifice, a Gaulin shears, expands, and smashes agglomerates down to their ultimate particle size.

Breaks them uniformly finer . . . mixes them evenly . . . to provide a host of important advantages.

Basically, the uniformly finer particle size a Gaulin provides, accents the dominant characteristics of a product. For example, it will *stop* separation. *Improve* texture, flow, lubricity. *Accent* taste, scent, color. *Speed* chemical reactions, or dispersion of ingredients. And *reduce* the amount of costly ingredients needed.

How about your product?

We'll be glad to show you just how a Gaulin can improve your product — and work with you toward solving any specific problems you may have. Write today for more information.

MANTON-GAULIN MFG. CO., INC., 71 Garden Street, Everett 49, Mass.

Some Typical Products Improved by Gaulin Homogenizers

PHARMACEUTICAL
Emulsions and dispersions. Gaulins make them stable, uniformly finer. Permit accurate reproduceability.

LIQUID STARCH
Improves transparency, clarity, and stops separation, at lower cost than other methods.

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Improves lubricating value and stability. Increases service life.

ESSENTIAL OIL EMULSIONS
Increases surface area to provide maximum flavor, scent, color. Makes them uniform and stable.

COSMETIC EMULSION
Gives smoother texture, longer shelf-life. Locks in perfume against evaporation.

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Makes accurate reproduceability possible. Provides uniform, stable emulsions and convenient viscosity control. Increases gloss.

GAULIN PILOT PLANT HOMOGENIZER
Ideal for experimental purposes, operation or process requiring up to 25 gallons per hour capacity. Handles quantities as small as one pint. Available on low rental basis.

GAULIN TWO-STAGE COLLOID MILL
Stator is jacketed for cooling or heating. Gap setting adjustable for .001" to .045". Only 45 seconds clean-up required in changing colors. 12" head room. 12" x 17" floor area.

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WORLD'S LARGEST MANUFACTURER OF HOMOGENIZERS, TRIPLEX STAINLESS-STEEL HIGH PRESSURE PUMPS, AND COLLOID MILLS

fluid: corrosive!

There's positive control with ASCO SOLENOID VALVES —even in hazardous areas

SPECIAL BULLETIN 8210A

It's a complex matter to control the flow of highly corrosive gases and liquids automatically—even more difficult in areas where an accidental spark could cause instant chaos. Yet the new ASCO Two Way Solenoid Valve with explosion-proof enclosure—designed to meet NEMA VII and UL requirements—provides for just such safe, automatic control.

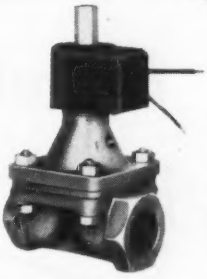
This all stainless steel Special Bulletin 8210A Solenoid Valve is self contained and requires no separate auxiliary pressure—and can be mounted in any position. Simple design—only two operating parts—the diaphragm and the all stainless steel solenoid core—assures foolproof operation.

The unique design and construction of the full line of ASCO Corrosion Resistant Valves facilitate the use of many special body materials. This is why ASCO Valves adapt to handle almost any corrosive gas or liquid. And ASCO Valves provide absolutely tight seating for pressures up to 1000 psi—function perfectly at temperatures to 450° F. – and are available in ⅛" to 3" pipe sizes. Standard, watertight, or explosion-proof enclosures may be specified.

There's *one* source that solves virtually any solenoid valve problem—ASCO. Have the ASCO engineer call—or write for data: "Solenoid Valves for Corrosive Applications."

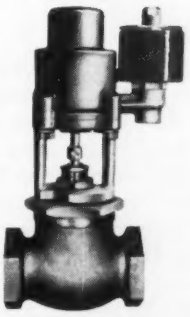
ASCO®
Automatic Transfer Switches
Electromagnetic Controls
Solenoid Valves
Automatic Switch Co.
381 Lakeside Avenue • Orange, New Jersey

Here are other typical ASCO *Valves for two and three way corrosive applications.*



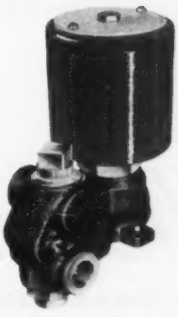
SPECIAL BULLETIN 8336

Especially suited for tight shut-off control of highly corrosive fluids containing suspended solids. Various body materials and diaphragms may be specified.



BULLETIN 8338

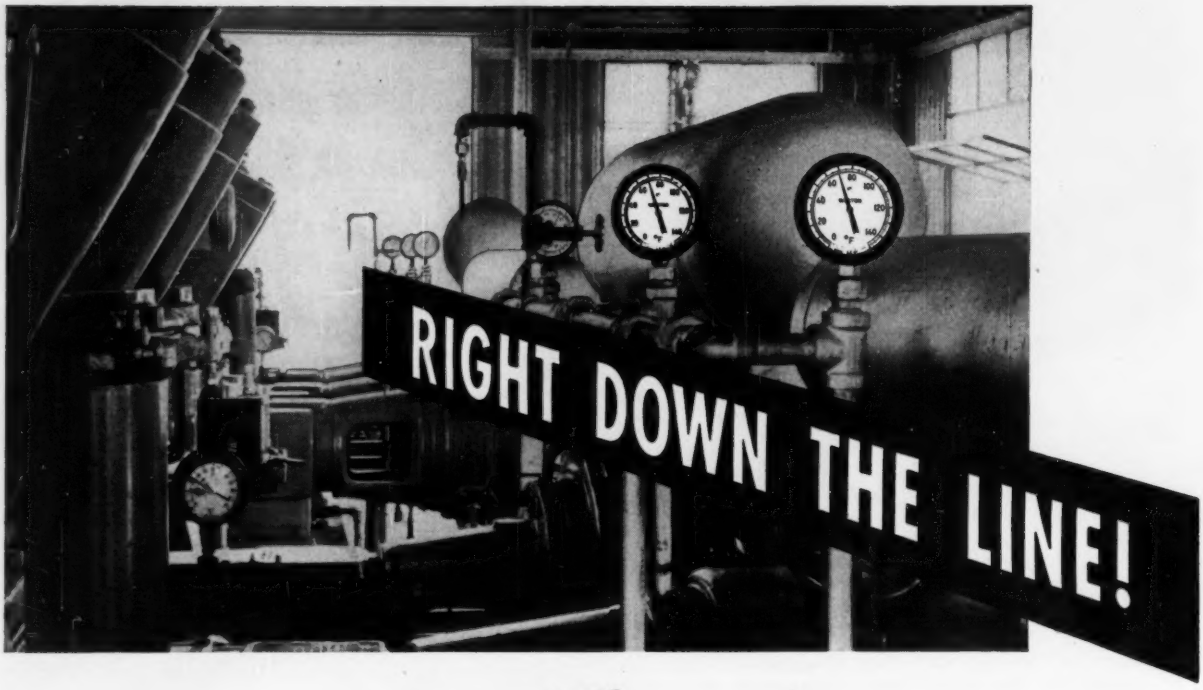
Cylinder operated, solenoid pilot controlled, closes on loss of auxiliary pressure. Construction makes it possible to use body materials that suit the corrosive fluid.



BULLETIN 8300

A three way valve for directing flow from a common inlet into one of two outlets. Available in all iron, steel, or stainless steel construction.

DEPENDABILITY



Weston thermometers with Multiple bimetal helix

The reasons why WESTON all-metal industrial thermometers excel in dependability and long life . . . enjoy such outstanding preference throughout industry . . . stem in large part from Weston's exclusive design and manufacturing methods. The critical *sensing elements* are all Weston-made in the shorter *multiple helix* form to insure rugged, *nonsagging* units. They are then *cycle-seasoned,* over broad temperature ranges, to insure *consistently precise indications* over far longer periods. Thus they serve better, longer, at far lower over-all costs. Bulletin containing sizes, ranges and prices, available on request. WESTON Electrical Instrument Corporation, 614 Frelinghuysen Ave., Newark 5, N. J.

WESTON
Thermometers

AVAILABLE THROUGH LEADING DISTRIBUTORS

Here's the utility can farmers prefer

A good way to build a bigger volume in the farm market among sportsmen, home gardeners, contractors, etc., is to deliver your product in a utility can that they *like* to use—and can easily *re-use!*

Tri-Sure* Nozzles, Spouts, Caps and Inner Seals on utility cans have the features that users want—easy pouring and filling.

The Tri-Sure filling Nozzle, with large 2⅛" opening, gives a big advantage—makes the can easy to center and easy to fill without flashback. This opening also acts as a vent in pouring. Tri-Sure Hex Caps and Inner Seals can be lithographed and embossed with your private design for product identification.

Give your product the competitive advantage of the utility can equipped with the *best closures*. Ask your supplier now for Utility Cans with *Tri-Sure Nozzles and Spouts and Inner Seals*.

Write for information on the complete line of Tri-Sure Products—Nozzles, Spouts, Seals, Screw Caps and Assemblies for Pails and Cans, and Tri-Sure Closures for Drums.

**The Tri-Sure Trademark is a mark of reliability backed by over 30 years serving industry.*

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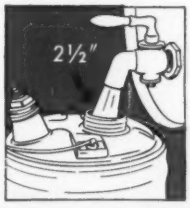
Tri-Sure
Reg. U. S. Pat. Off
CLOSURES

2 SIZES FOR POURING

Double Hex Cap extends spout and makes it easy to get to inaccessible openings.

EASY TO POUR

Spouts available in standard 2" and long 2¾" sizes. Rigidity of the closure makes it easy to rest spout on filling opening. When container is full, stream pours clear of chime.

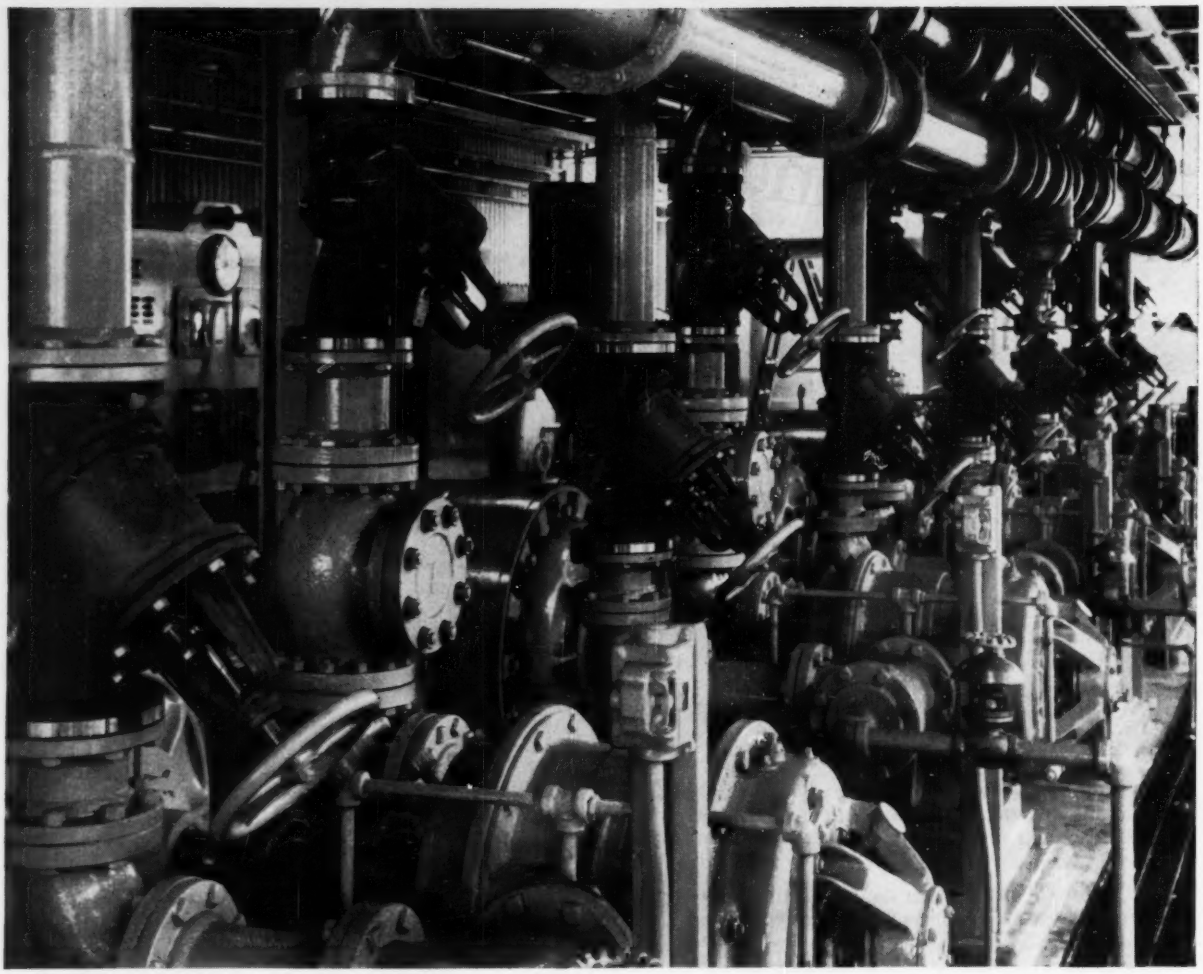


EASY TO RE-USE

Large opening makes can easy to clean out and re-fill.

PROTECTION

Closures are above pail head chime eliminating water seepage. Heavy-weight Nozzles and Spouts are gasketed in the clinching rim for complete protection.



Chlorine handling equipment

about the corrosion resistance of TITANIUM...

To keep abreast of the latest developments on this vital metal, write to Dept.CE8 for the Rem-Cru Review—a free periodical presenting the latest technical data on titanium alloys.

Among commercial metals, titanium's resistance to corrosion is unique. Take, for example, its resistance to chloride ion attack. Corrosion rates of nil to 0.15 mils per year are reported for titanium immersed in hot and boiling solutions of cupric and ferric chloride, sodium and calcium hypochlorites.

It is right here that pitting from chloride attack causes other structural metals to fall down. This is why titanium should be specified for valve trim, drums, rollers, presses, heat exchangers and other equipment exposed to unusually corrosive conditions like these.

Titanium's resistance is proven in many other corrosive environments. You'll find it pays its way many times over through long life . . . less down time . . . less product contamination. Let REM-CRU engineers work with you to make the best use of this versatile new metal for your applications.

REM-CRU's expanded facilities mean *fast* delivery of titanium—in the form you want it.

REM-CRU TITANIUM

REM-CRU TITANIUM, INC., MIDLAND, PENNSYLVANIA

THINGS TO COME...WITH

Glycerine

TASTY CREAM CANDIES... *with longer shelf life*

Candy makers have a problem when cream fillings develop disagreeable taste and odor after a few weeks on store shelves.

They've looked long and hard for a way to eliminate this spoilage which is caused by the formation of free fatty acids.

Researchers have tried to stop or slow down the reaction by adding chemical retardants. But taste and texture could not be sacrificed.

Tests have shown that in some cases addition of 1-2% *Glycerine* almost doubles shelf life, promising a more trouble-free future for the candy industry.

The unique balance of properties that won such wide acceptance for Glycerine in the candy industry in the past continues to open new doors to progress. In paints, foods, pharmaceuticals, packaging . . . for tomorrow's surge of new specialties . . . in formulations and reactions yet unknown. *Nothing takes the place of Glycerine.*

This balanced group of properties keeps **Glycerine's** usefulness growing

HYGROSCOPICITY • STABILITY •
SOLVENT POWER • VISCOSITY • NONVOLATILITY •
NONTOXICITY • TASTE • MW/HYDROXYL RATIO •
HUMECTANT •
CARRIER • SOLVENT • LUBRICANT • SOFTENER •
EMOLLIENT • ANTI-FREEZE • ALKYD BASE •

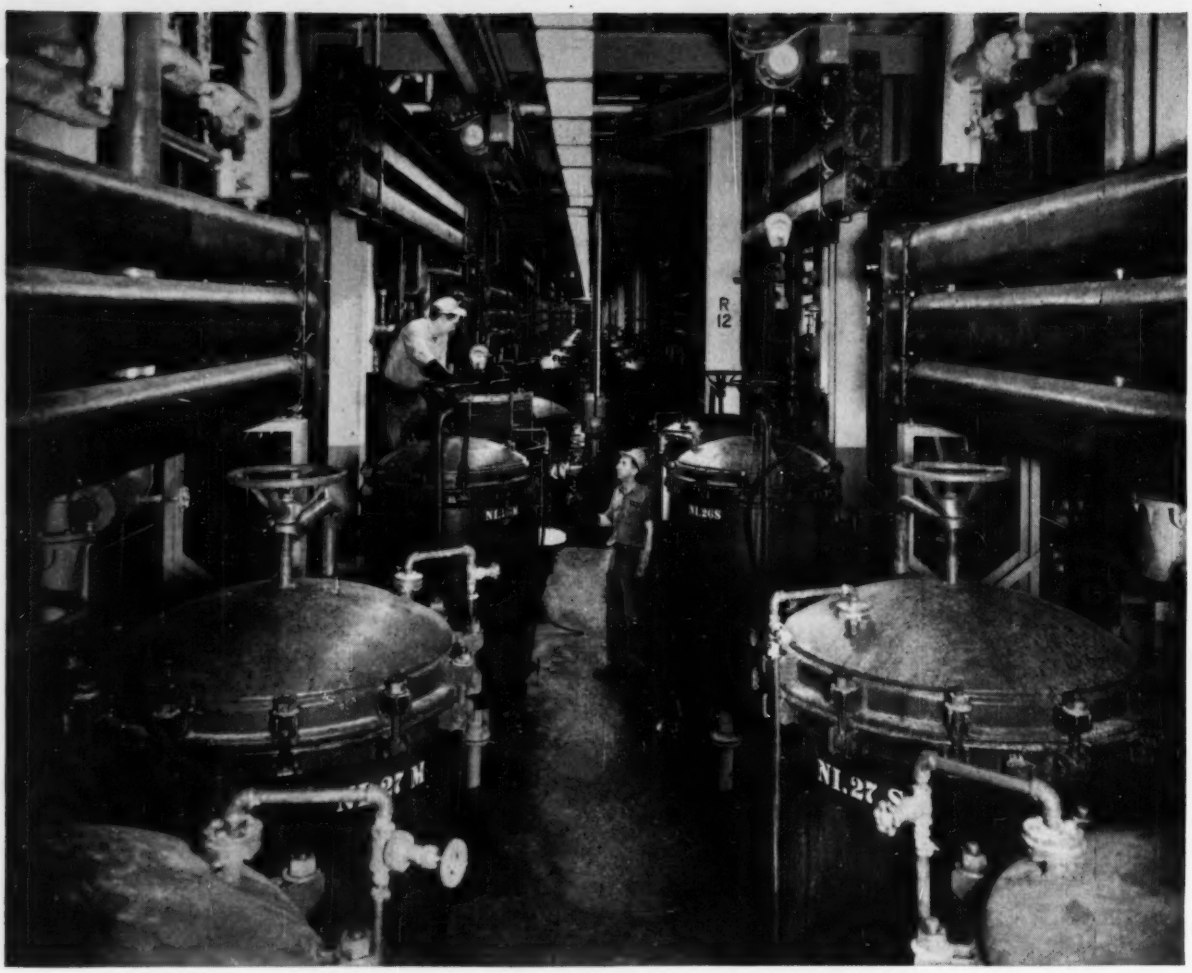
☑ CHECK AND SEND FOR TECHNICAL DATA

☐ 20-page booklet on Glycerine for product conditioning

☐ 12-page booklet on Glycerine standards and specifications

☐ 16-page booklet on Glycerine properties and applications

For your free copy of any or all of these booklets write: **GLYCERINE PRODUCERS' ASSOCIATION** • 295 Madison Ave., New York 17, N. Y.



48 Sparkler Horizontal Plate Filters in this installation

Why do the largest plating plants in the world Choose SPARKLER FILTERS?

The answer is simple, and obvious to plating engineers.

First — the cake on a Sparkler Horizontal plate filter will not crack or fall off with a variation in pressure or with a complete shut down of filtering. ***Second*** — dry cake disposal eliminates the sewer problem. ***Third*** — the quick-change plate assembly reduces the down time for cleaning each filter to a matter of minutes.

These same features of the Sparkler Horizontal plate filter that are so attractive to the plating field are also the reasons why Sparkler filters are used so extensively in the processing of chemicals and pharmaceuticals.

Chemical Engineers can get full cooperation at Sparkler on any size installation.

SPARKLER MANUFACTURING CO., Mundelein, Ill.

Filtration engineering and manufacturing has been our exclusive business for over 30 years

Manufacturing plants in Canada, Holland, Italy, Australia

Service representatives in principal cities throughout the world

Aluminum paint Saves on all these maintenance jobs

Reflects sun's heat to hold down inside temperatures—reduces evaporation losses.

Extends life of rustable metal windows—eliminates costly repairs.

Protects piping against rust—provides insulation to cut heat losses.

Seals masonry against moisture in locker and shower rooms.

Brightens plant interiors—improves employee efficiency and morale.

Makes fire escapes and stairs safer—improves lighting in stairwells.

PLANT MAINTENANCE COSTS $2 BILLION EVERY YEAR!

ALUMINUM PAINT reduces this expense —resists rust and corrosion

Aluminum paint seals against moisture and fumes and therefore resists rust and corrosion—reflects light and heat, reduces evaporation—improves appearance—and One Coat usually covers.

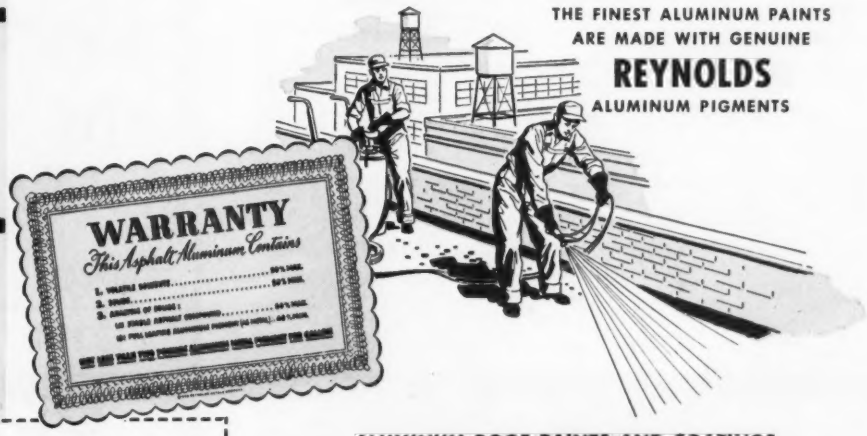
Here, then, is a way to slash your cost of plant maintenance and replacement. Good aluminum paint actually puts a *protective shield* on rustable metal and masonry surfaces. Labor—the largest cost in painting—is low because in most cases only one coat of aluminum paint is needed. To be sure of one coat protection buy a quality brand.

Reynolds Metals Company does not make aluminum paint. But if you would like the names of manufacturers who rely on the high quality of Reynolds Aluminum Pigments, we'll gladly send you the list. Just use the coupon below.

THE FINEST ALUMINUM PAINTS ARE MADE WITH GENUINE

REYNOLDS

ALUMINUM PIGMENTS



ALUMINUM ROOF PAINTS AND COATINGS ADD YEARS AND YEARS TO ROOF LIFE

Asphalt-Aluminum roof paints and coatings provide low-cost, long-life protection for built-up and rustable metal roofs. Also reflect sun's heat for cooler buildings in summer. Insist on Asphalt-Aluminum roof paint or coating with this Warranty Seal. It assures you of an approved vehicle and at least two full pounds of pure aluminum pigment in every gallon.

Reynolds Metals Company
P. O. 1800-PN, Louisville 1, Kentucky

Please send me information about Aluminum Paints and Roof Coatings

☐ Also send list of aluminum paint manufacturers

☐ Also send list of asphalt-aluminum roof paint and coating manufacturers

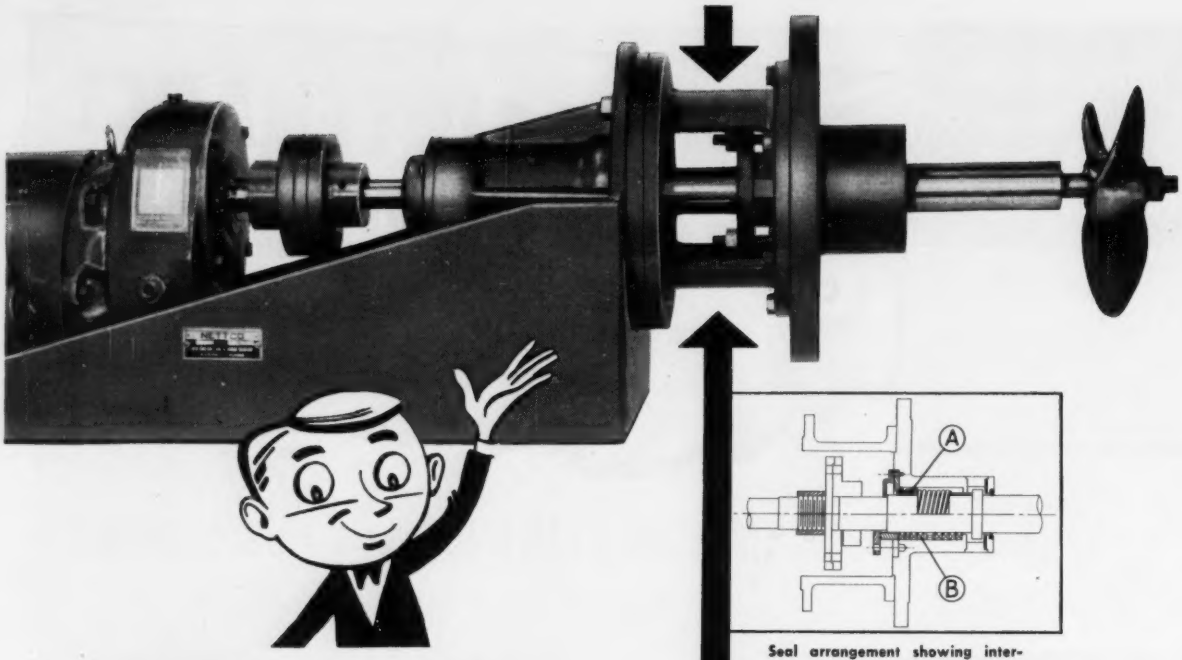
Name .....

Company .....

Address .....

City ..... Zone ..... State .....

This advertisement appears in the interest of the Paint Industry of America

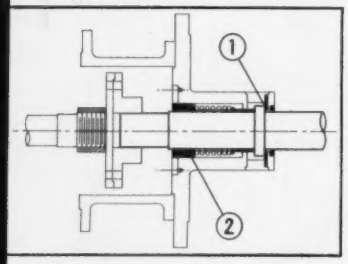


THIS MIXER'S A MAINTENANCE MISER

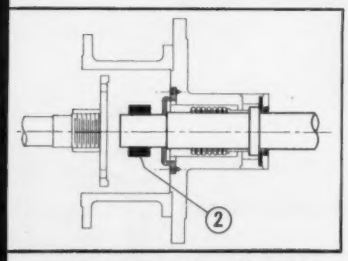
Nettco Side Drive Mixers are now available with mechanical shaft seals of unsurpassed lasting qualities. The Nettco design permits seal inspection or service under full pressure . . . without draining storage tanks or other time-consuming preparations. The seal service operation is simple, quick, inexpensive. If repair parts are not available, the complete assembly can be replaced by a conventional stuffing box. *Only Nettco offers this feature!*

Nettco Side Drive Mixers with the "maintenance-miser" seal are available in ⅓ to 30 HP sizes . . . in many arrangements and alloys to suit specific job requirements. Next time check Nettco — for prices and recommendations. New England Tank & Tower Co., **87** Tileston St., Everett 49, Mass.

Seal arrangement showing interchangeability of mechanical seal (A) and conventional stuffing box (B).



Mechanical seal isolated from tank pressure by secondary shut-off collar 1. with seal parts 2. exposed for inspection.



Seal in open position with split flange coupling removed for repair or replacement of seal parts 2.

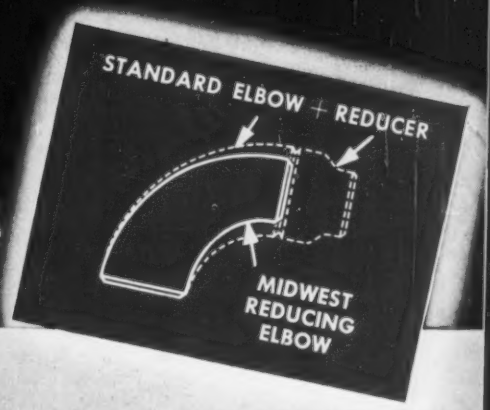
Send for new Side Drive Bulletin #532.

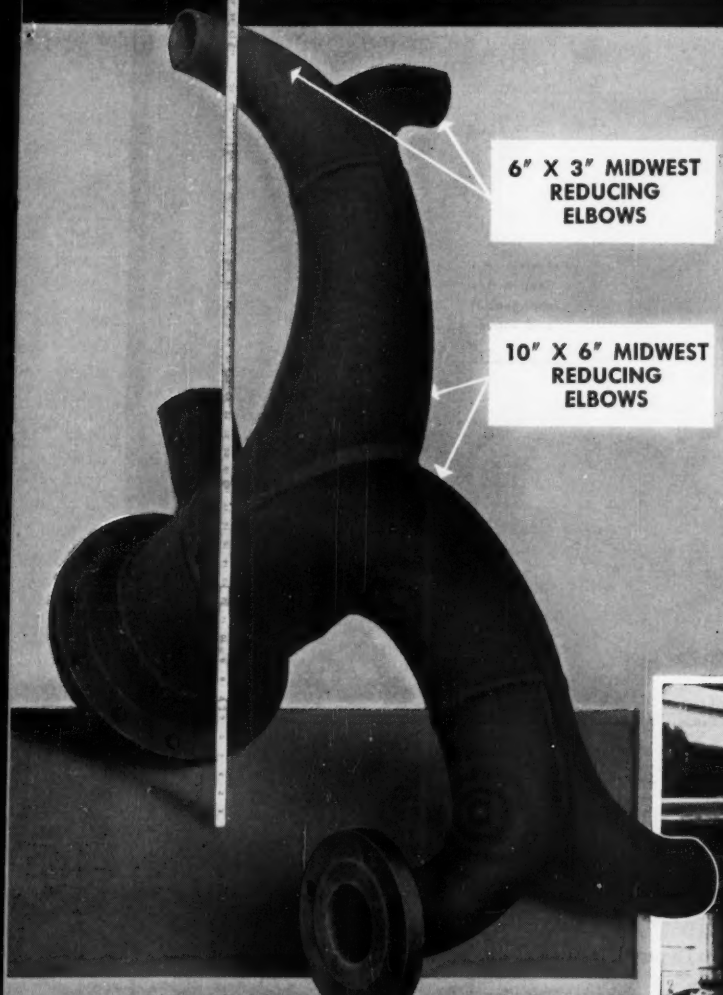
NETTCO

ENGINEERED AGITATION

Better Piping at a Better Price

by Using MIDWEST REDUCING ELBOWS



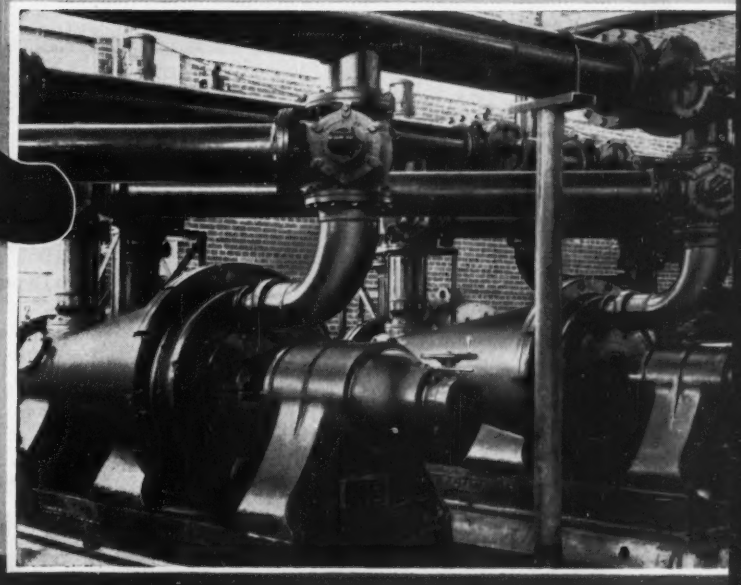


The Midwest Reducing Elbow offers important advantages in both piping design and piping cost. It needs only two welds instead of the three required by a standard elbow and a reducer (see sketch above). There is also a saving in layout time. Turbulence and pressure drop are reduced by the gradual taper . . . less space is needed . . . insulation is easier . . . and piping appearance is improved.

Only Midwest Reducing Elbows are available from stock in sizes to 16" . . . larger on special order. They have the same dimensional accuracy, uniformity of wall thickness, exact included angle and true center-to-end dimensions of Midwest Straight Elbows. For further information, ask for Catalog 54.

6999

Midwest Reducing Elbows made it possible to fabricate this transformation piece for a boiler feed suction line so that it could be installed in the limited space available and still get the benefit of streamline flow. There was also a cost saving in comparison with a less efficient and bulky assembly made with straight tees, ells and reducers.



Paper stock flows with minimum resistance through Midwest Reducing Elbows from 8" connection on Jordan to 10" header. Other advantages over standard elbow and reducer: a saving in cost and space, and improved appearance.

MIDWEST WELDING FITTINGS
Improve Piping Designs
and Reduce Costs

MIDWEST PIPING COMPANY, INC.

Main Office: 1450 South Second Street, St. Louis 4, Mo.

Plants: St. Louis, Passaic, Los Angeles and Boston

STOCKING DISTRIBUTORS IN PRINCIPAL CITIES

RELIABLE FLUID MIXING in PROCESSING

Fiberglas sets world's "elbow-bending" record!

THIS COMPLETE ELBOW COVERING FABRICATED IN ONLY 29 SECONDS!
Simple pie cuts with an ordinary knife produce perfectly fitting segments. No hacking . . . no sawing!

Yes, for speedy handling and fabrication on the job—not only elbows but straightaway runs and odd-shaped equipment, fittings and ducts—Fiberglas* Insulations recognize no equal! Such performance is possible because Fiberglas is light, rigid, non-crumbling, so easy to cut. What a time-and-labor saver! Moreover, it's moisture-resistant and dimensionally stable . . . combines sound absorption with thermal efficiency. Want to test its workability for yourself? Just write, Owens-Corning Fiberglas Corporation, Dept. 97-H, Toledo 1, Ohio.

Fiberglas PF Panels for equipment and ducts possess the same workability as the Pipe Covering illustrated at top of page.

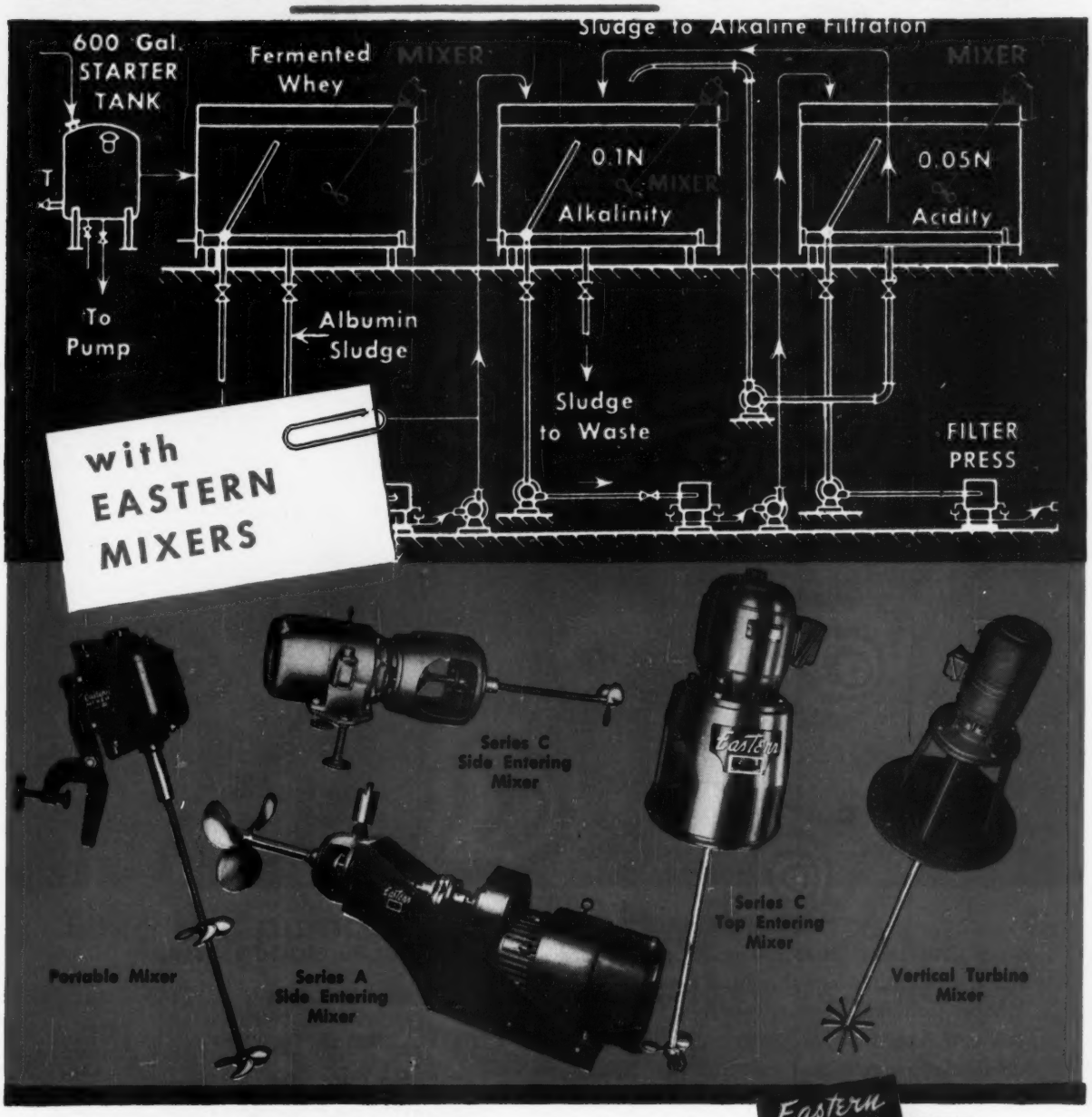
For High Temperatures—KAYLO®, King of High Temperature Insulations. A faultless performer up to 1200° F. Distributed by Owens-Corning Fiberglas Corporation.

Technical data will be found in Sweet's File, Chemical Engineering Catalog and Refinery Catalog.

OWENS-CORNING
FIBERGLAS

*T. M. Reg. Owens-Corning Fiberglas Corporation
®Kaylo is mfd. by Kaylo Div., Owens-Illinois Glass Co., Inc.

RELIABLE FLUID MIXING in PROCESSING



Eastern's Mixers are designed to meet the needs of today's chemical and industrial processes. Many types are available to satisfy all conditions of fluid consistencies and tank sizes. Selection may be made from a wide range of horsepower, speed, and construction materials. Motors with various voltage ratings and enclosures are also furnished.

PORTABLE MIXERS

Series H at 1725 R.P.M., Series S at 1125 R.P.M., and Series G at 420 R.P.M. are available in motor ratings from 1/20 to 5 H.P. Also available are special speeds, variable speeds, as well as air driven models.

TOP AND SIDE ENTERING

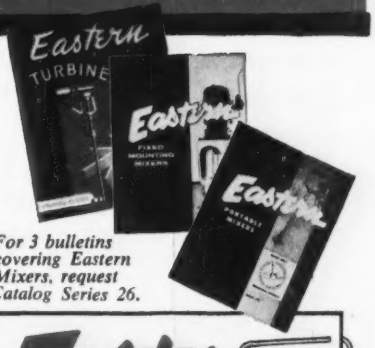
Series A, extra heavy duty for large tanks, are available in side entering units only within a range of 5-30 H.P. with standard speeds of 280, 420, and 1150 R.P.M.

Series C, for average tank capacities, are available in sizes of ¼ to 10 H.P. at these standard speeds: 1725 R.P.M. (up to 5 H.P.); 1140 R.P.M. (up to 10 H.P.); 420 R.P.M. (up to 7½ H.P.); 280 R.P.M. (up to 5 H.P.). Available in both horizontal and vertical models.

TURBINE MIXERS

Eastern's Top and Bottom Entering Turbine Mixers find particular application where liquid blending requires gentle, yet thorough agitation.

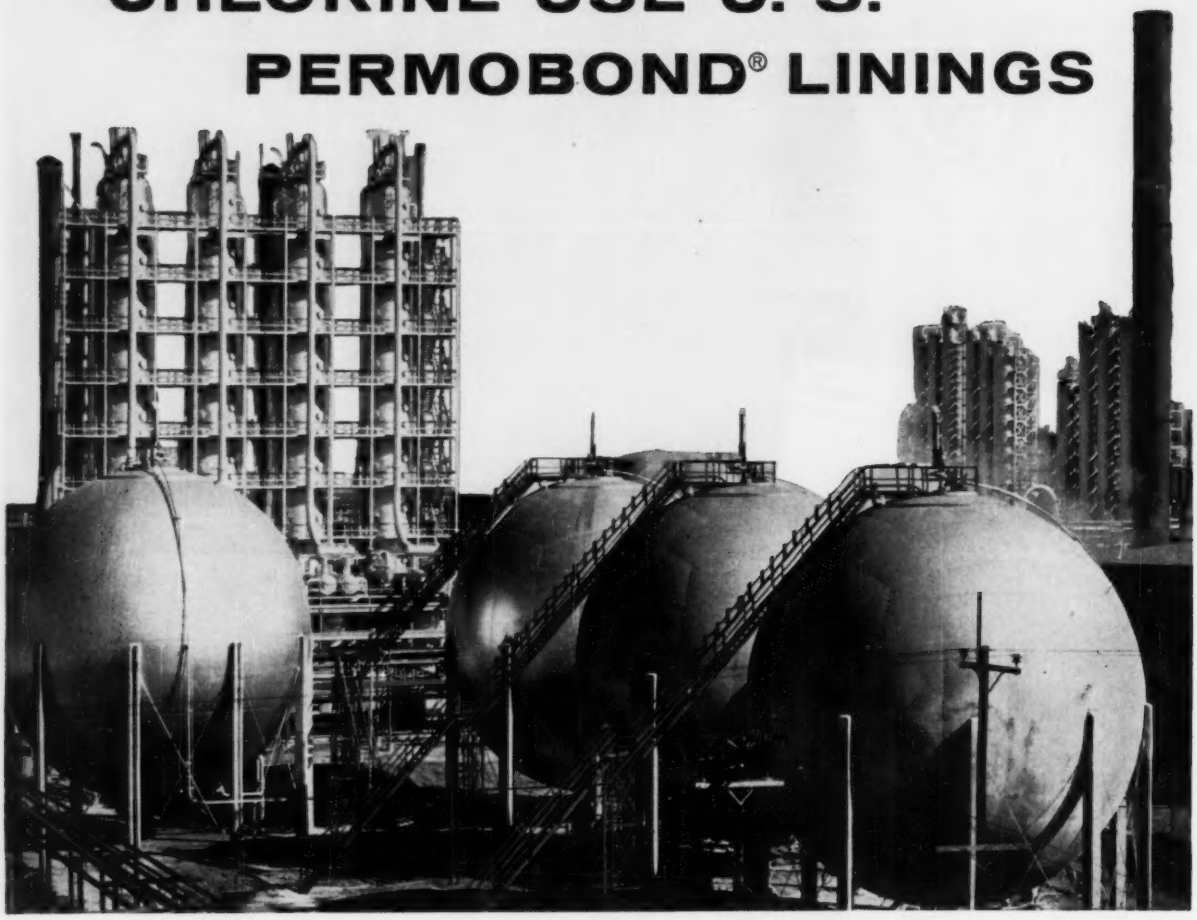
Models are available in sizes from ¼ to 40 H.P. Standard speeds are 56, 68, 84, 100, 125, 155 R.P.M.



For 3 bulletins covering Eastern Mixers, request Catalog Series 26.

Eastern
INDUSTRIES, INC.
Mixer Division
Regent St., Norwalk, Conn.

PRODUCERS OF CHLORINE USE U. S. PERMOBOND® LININGS



Since Chlorine is produced under highly corrosive conditions and because United States Rubber Company's specially compounded Permobond #5471 proves superior for lining the amalgam type cells plus the piping and process tanks, then *you can be sure* that U. S. Permobond is the right lining for *all* chemical processes using this highly corrosive basic chemical.

Any original equipment requiring protection against corrosive attack can be lined with Permobond. You can also have Permobond installed on existing equipment—*right in your own plant.*

U. S. PERMOBOND PROTECTS AGAINST

- **WET OR DRY CHLORINE**
- **TEMPERATURES UP TO 200°F.**
- **SATURATED CHLORINE SALT BRINE REGARDLESS OF CONCENTRATION**

"U. S." has a field force of special sales engineers to solve your corrosion problems. Get in touch with them at the address below.

FROM EVERY STANDPOINT, PERMOBOND #5471 IS THE SUPERIOR LINING.

US RUBBER

"U. S." Research perfects it..."U. S." Production builds it...U. S. Industry depends on it.

UNITED STATES RUBBER COMPANY

MECHANICAL GOODS DIVISION · ROCKEFELLER CENTER, NEW YORK 20, N. Y.

Hose • Belting • Expansion Joints • Rubber-to-metal Products • Oil Field Specialties • Plastic Pipe and Fittings • Grinding Wheels • Packings • Tapes Molded and Extruded Rubber and Plastic Products • Protective Linings and Coatings • Conductive Rubber • Adhesives • Roll Coverings • Mats and Matting

Exploring the operating advantages of Goulds Fig. 3715 chemical pump.

Take this pump apart right in your office . . . and you'll see how it can *save* you *money*

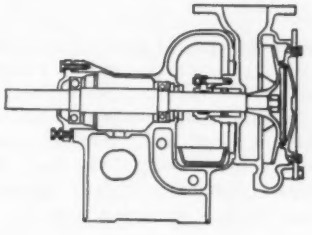
You'll find new features in the Goulds Fig. 3715 chemical pump.

They're features that make it a rugged, dependable, long-lived pump for handling corrosive liquids. And you can check them yourself without moving away from your desk.

We've built an aluminum model of the Fig. 3715 pump — complete in every detail. Ask your Goulds representative to show it to you.

You can open it up, take it apart, and see in detail such features as the easy method for adjusting impeller clearance—the chamber for cooling the support head so that you can operate the pump up to 350° F.—the design that permits you to inspect and clean the inside of the pump without disturbing the piping.

Call your Goulds representative today. Tell him you'd like to examine the Fig. 3715 model and he will gladly set a date at your convenience. Or write us in Seneca Falls and we'll make the arrangements promptly.



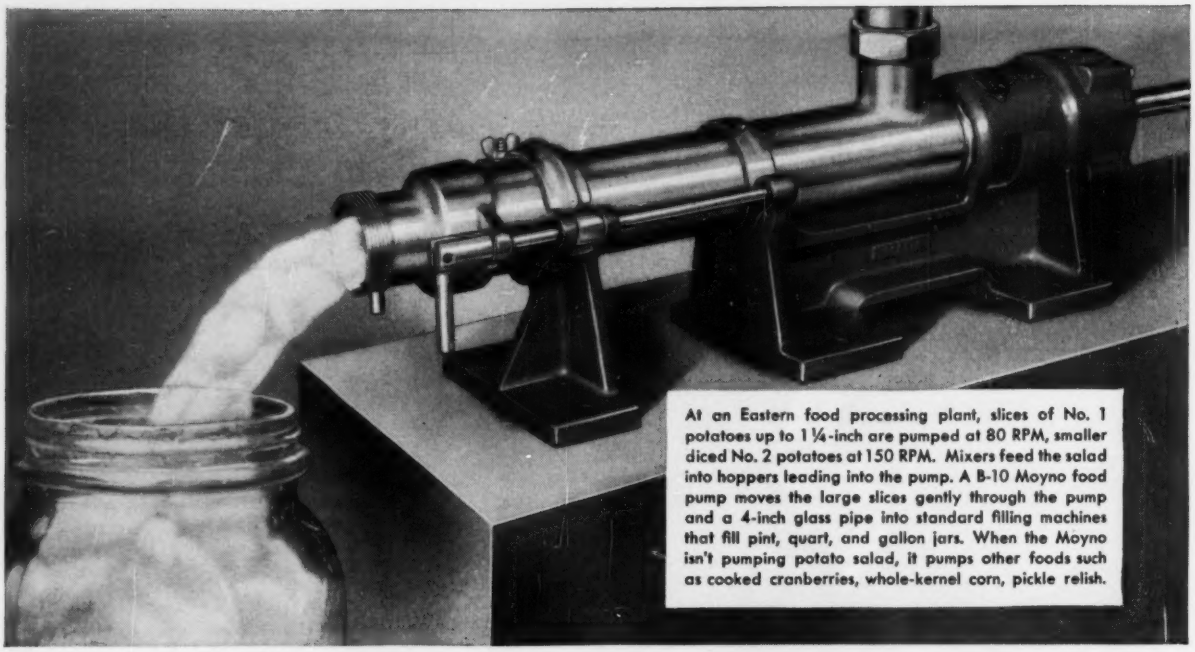
CROSS SECTION of Fig. 3715 pump.

You can get the Goulds Fig. 3715 pump in an alloy to meet your liquid handling requirements, including 316 and Gould-A-Loy 20 stainless steels, all iron, all bronze, bronze-fitted,—iron with stainless trim, or bronze with stainless trim. And it's available in 9 sizes providing capacities up to 720 GPM, and heads up to 200 ft. For additional details write for Bulletin 725.4.

MEMBER

Goulds PUMPS INC. Seneca Falls New York

Atlanta • Boston • Chicago • Houston • New York • Philadelphia • Pittsburg • Tulsa



At an Eastern food processing plant, slices of No. 1 potatoes up to 1¼-inch are pumped at 80 RPM, smaller diced No. 2 potatoes at 150 RPM. Mixers feed the salad into hoppers leading into the pump. A B-10 Moyno food pump moves the large slices gently through the pump and a 4-inch glass pipe into standard filling machines that fill pint, quart, and gallon jars. When the Moyno isn't pumping potato salad, it pumps other foods such as cooked cranberries, whole-kernel corn, pickle relish.

This Moyno® Pumps Potato Salad With Slices Up To 1¼-inch...Without Crushing!

The Moyno can pump potato salad and a lot of other materials without making mush out of them—because of the unique *progressing cavity* principle.

Moynos have no valves and pistons, no vanes or other devices that cause churning and turbulence. The Moyno has a simple screw-like rotor turning within a double-threaded stator. This design creates cavities which progress smoothly toward the discharge end of the pump, carrying the material being handled. The material is not squeezed or churned.

Pumps Practically Anything

That's why the Moyno successfully handles such hard-to-pump materials as non-pourable pastes, frits, plaster, highly volatile liquids, and materials containing large particles, such as potato salad, fruit, cherries, chow mein—even oysters! In fact, the Moyno handles practically anything that will pass through a pipe.

Many Other Advantages

Moynos pump many hard-to-pump materials with a minimum of abrasion and wear. Many plants have adopted Moynos simply because they last so long.

Moynos provide positive displacement. Moynos can pull up to 29 inches vacuum while discharging under pressure. Big Moynos deliver up to 500 gpm; can provide pressures up to 600 psi in the smaller frame sizes. They even get up to 1000 psi momentarily.

The Moyno is reversible—it pumps equally efficiently in either direction.

With the Moyno, accurately metered flows are obtainable by regulating operating speed.

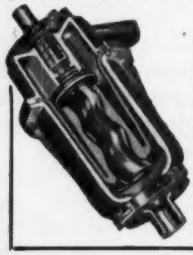
Moynos are trouble-free. They are self priming; won't cavitate or vapor-lock. There's just one moving part—no valves to stick, no pistons to gum up. Built for tough service. Easy to maintain. Moyno pumps are easy to take apart for cleaning.

Write For Bulletin

You may save a good deal of money or solve a tough problem by finding out about this simple, versatile pump. Write for Bulletin 30CE.

HOW IT WORKS

Rotor is like a stretched-out corkscrew. It turns within a stator that has a double internal thread. Thus rotor and stator form closely fitted cavities. As the rotor turns, these cavities progress evenly toward the discharge end of the pump without closing up. That's why the Moyno easily handles materials without crushing, churning, or aerating; and why it can handle so many different things—solids in suspension, pastes, abrasives, highly volatile liquids, tars, soaps, caustics—even cement and plaster.



FOR DESIGN ENGINEERS

Moynos are available in small sizes and special designs for use in automatic washers, drink dispensers, sprayers, oil burners, machine tools, gasoline pumps, and a wide variety of other equipment. If you are designing machinery, we'll work with you, in confidence, to integrate pump design with your problem.

ROBBINS & MYERS, INC.

SPRINGFIELD, OHIO • BRANTFORD, ONTARIO

R&M®

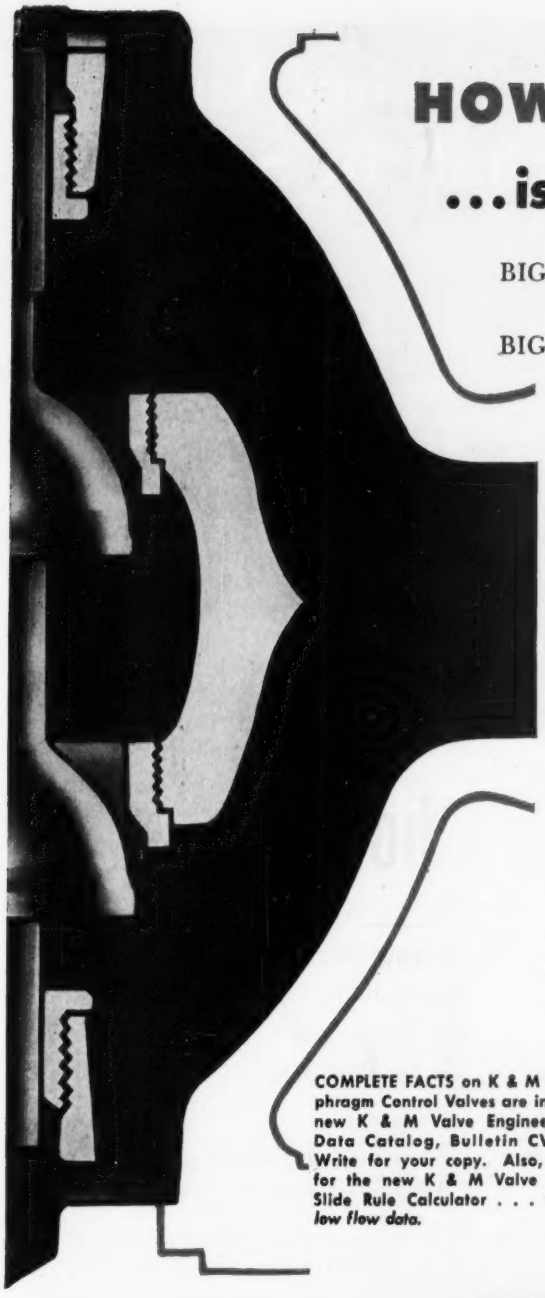
Fractional and Integral HP Motors

Desk, Window, and Household Fans

Hoists and Cranes

Moyno Pumps

Propellair Industrial Ventilating Equipment



HOW BIG

...is a K & M six-inch valve?

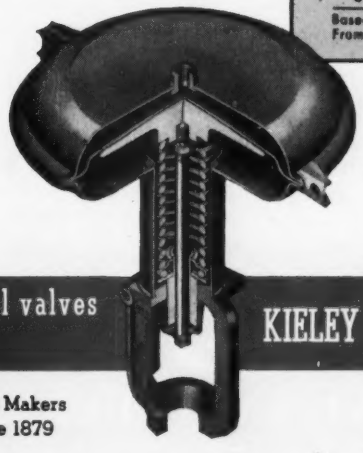
BIG enough to pass 500 gpm of cold water through the valve body at a constant drop of one pound pressure. BIG enough to provide the largest flow coefficient available in a standard six-inch diaphragm control valve. Body flow passages of all K & M valves, for example, actually average 140% of cross-sectional pipe area. There's more space for fluid to flow . . . smoothly, freely and without turbulence. Frequently a smaller nominal size K & M Valve provides sufficient capacity to satisfy requirements that formerly called for a larger, more expensive valve. Inner valve open areas, on the other hand, average only 80% of cross-sectional pipe area. Therefore, flow restrictions occur principally across the inner valve . . . where the restriction is controllable throughout the entire range of valve stem travel. This K & M design often permits lower initial costs . . . always contributes to more precise flow regulation through the K & M Inner Valve.

COMPLETE FACTS on K & M Diaphragm Control Valves are in the new K & M Valve Engineering Data Catalog, Bulletin CV53. Write for your copy. Also, ask for the new K & M Valve Size Slide Rule Calculator . . . with *low flow data.*

C_V COMPARISON TABLE

Valve Size	K & M	Valve B	Valve C
¾"	10.9	8.4	8
1"	17.3	14.9	12
1½"	39.1	33.2	28
2"	61	57	48
2½"	97.7	71.0	72
3"	150	116	100
4"	219	197	165
6"	500	364	360

Based on the maximum C_V at rated travel through the valve body. From manufacturers most recent slide rules or tables.



diaphragm control valves

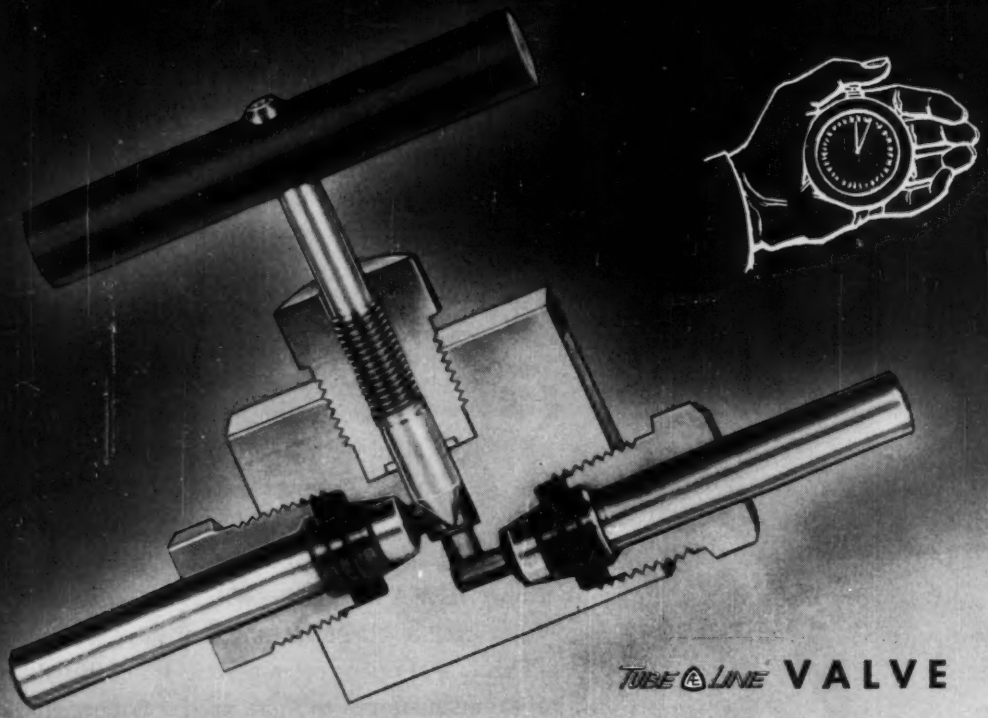
K&M

Valve Makers Since 1879

KIELEY & MUELLER, INC.

64 Genung Street
Middletown, New York

NEW... Low Cost Tubing Valve You Can Install in Seconds



TUBE-A-LINE VALVE

- No Pipe Threading
- No Beveling
- Gas Tight Seal Up To 4000 P.S.I.

Here is a high quality, low-cost valve for tubing . . . the NEW TUBE-A-LINE Valve. You can cut it into the lines in a jiffy . . . requires no threading, no beveling, no pipe-wrench . . . and every joint is a union. What's more, this new valve costs less initially and works better than any conventional screw-end valve.

Here's how the TUBE-A-LINE Valve works: Cut tubing to required length, slip adapter nut and sleeve on, insert into valve and tighten joint . . . a gas-tight seal up to 4000 p.s.i. in a matter of seconds.

The TUBE-A-LINE Tubing Valve body is made of 304 stainless steel, the stem is 410 stainless steel heat treated and ground, with rolled threads. Gland nut is 416 stainless steel, the stem thread is in the gland nut and outside the pressure zone.

Full details on TUBE-A-LINE Tubing Valves are available in Bulletin 255. Write for it.

TUBE-A-LINE

AUTOCLAVE ENGINEERS, INC.

860 EAST 19TH ST. • ERIE, PENNSYLVANIA

You get more than a conveying system at

SPROUT-WALDRON

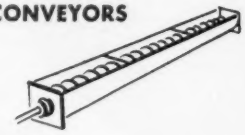
You get many *plus* values when you deal with Sprout-Waldron. In conveying systems, you get a wide choice of types, styles, and sizes. And all can be tailored to fit your needs by Sprout-Waldron's unique methods of "adaptioneering."

You also get reliable guidance on installations and applications from our engineering representatives and engineering staff. Their recommendations are based on long experience and backed by case history files of successful processing applications and laboratory tests.

DAVE SMYTH

A member of Sprout-Waldron's Quarter Century Club, Dave Smyth has been serving the needs of his customers for 27 years. And before joining Sprout-Waldron, he served the processing industries through a mill supply house. Industrial America's biggest names have profited by Dave's assistance in solving problems. With such men to help you, you're bound to buy *right* at Sprout-Waldron.

SCREW CONVEYORS



Sprout-Waldron vertical and horizontal screw conveyors are extremely low in maintenance and moderate in power requirements. Available in conventional helicoid, continuous sectional, and sectional types. Ask for literature.

BUCKET ELEVATORS

Sprout-Waldron offers bucket elevators in bucket sizes from 3" x 3" to 30" x 16"... wood, stainless steel, carbon steel, and aluminum . . . chain or belt, high speed or conventional. Write for full facts.

FEEDERS

You'll find the simplest, sturdiest, and easiest - to - maintain feeders at Sprout-Waldron. Ours is the most extensive line to be found anywhere. And the many years of experience we have gained through pioneering in this specialized field assures you of the greatest possible savings. Get details.

SPROUT SW WALDRON

SPROUT-WALDRON

PNEU-VAC

pays **11** *ways*

1. **Increased production—greater safety.**
2. **99.96% material recovery.**
3. **Lower maintenance costs.**
4. **No product intercontamination.**
5. **No fan wear.**
6. **No infestation.**
7. **No handling losses.**
8. **Elimination of exterior dust.**
9. **Improved working conditions.**
10. **Small space requirements.**
11. **Horizontal, vertical, around corners.**

In this modern, negative-pressure or draw-through system, the fan is located on the opposite side of the collector from the material conveying line. Material does not pass through the fan. Mechanical friction and exterior dusting are eliminated. The unit is self-cleaning. It can cool, heat, aerate, or dry. Materials can be routed anywhere you can run a pipe. There is a minimum of moving parts.

Thorough experience in application and design is essential to getting best results from any pneumatic system. Sprout-Waldron is one of the country's foremost designers and builders of pneumatic systems, and has been manufacturing Pneu-Vacs for more than 9 years. Be sure to compare Pneu-Vac with all others before installing any pneumatic conveying equipment. Write for details.

SPROUT-WALDRON

Manufacturing Engineers Since 1866

15 LOGAN STREET • MUNCY, PA.

Equipment for { SIZE REDUCTION, MIXING & BLENDING, PELLETING & CUBING, BULK MATERIALS HANDLING, PRODUCT CLASSIFICATION

Facilities for fabricating, machining, custom founding, woodworking, laboratory testing

PR/394

Specialty
Safety Products

SPLASHPROOF
NEW AO† H5 Face Shield!

Unique Structural Features Simplify Window Interchange

H-5
FACE SHIELD

Features a full crown or spark deflector, new quick-fastening studs in front, and end clips which hold window securely. Chemical splashes cannot enter between window and headgear. Offers excellent impact protection also. Available with acetate windows (clear or green), 24-mesh screen, and fibre. All windows optically correct and extra large (18¼" x 10").

124SB-3 STRAIGHTAWAY
SOUND PROTECTOR

MUFFLES HARMFUL PLANT NOISE!

A new addition to AO's Sound Protector line which accommodates larger ears, cuts out harmful noise. This headband is rugged, will withstand abuse, is adjustable and has padded headband. All connections insulated. Oval shaped ear cups fit snugly, stay comfortably in place and are especially designed for larger shaped ears — also to seal opening at jawbone section. The 124SB-3 is available with built-in earphones.

KEEPS EYE PROTECTION EQUIPMENT CLEAR AND CLEAN!

851
HEAVY DUTY
CLEANING
STATION

This cleaning station will keep your plastic goggles, safety shields, any protective surface clean. Fluid is pressure packed. No pump, fuss or mess. Very economical in use. 20 gauge steel container is pilfer-proof. Provides for tissue disposal. Unit consists of dispenser, cleaning and anti-fog fluid and jumbo size filling of paper.

American Optical
SAFETY PRODUCTS DIVISION

SOUTHBRIDGE, MASSACHUSETTS • BRANCHES IN PRINCIPAL CITIES

YOUR NEAREST AO SAFETY PRODUCTS REPRESENTATIVE CAN SUPPLY YOU

†T.M. REG. BY AMERICAN OPTICAL COMPANY

PROVED—AT HIGH TEMPERATURES

WEDGEPLUG
NON-LUBRICATED
STEEL PLUG VALVES

"Wedgeplug Performance Saves You Money"

Write for Wedgeplug Catalogue No. 54-1-W

WEDGEPLUG VALVE COMPANY, INC.
New Orleans 25, La.

An Affiliate of

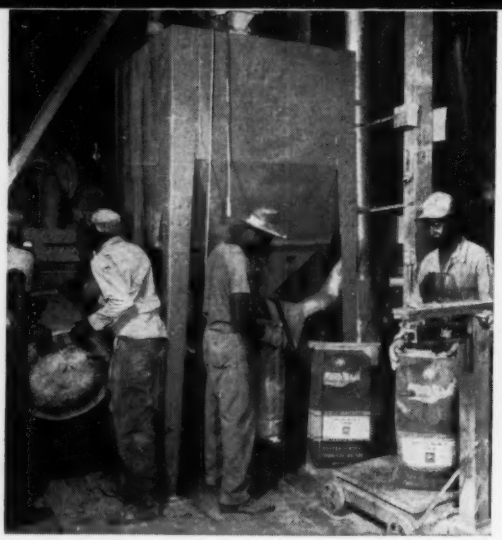
STOCKHAM VALVES & FITTINGS
General Offices and Plant • Birmingham 2, Ala.

DEPENDABLE - ECONOMICAL

Wedgeplug Valve Design eliminates the need for plug lubrication, and assures quick, positive action thru a wide range of temperatures and pressures . . . The plug lifts, turns, and reseats on its protected seating surfaces in one conventional operation . . . Wedgeplug Valves—in general service and in special service all over the world — have established a reputation for dependability and economy, both in first-cost and operation.

How Cotton States Chemical Company lifted the blackout on production problems with DUSTUBE® collectors

A curtain of chemical dust blacks out a portion of production profits by permitting the escape of valuable material. Cotton States Chemical Co. lifted this curtain through the use of 3 Wheelabrator Dustube Collectors in the manufacture of agricultural chemicals. One ventilates blenders and "sack-off" stations. Another ventilates a mill that grinds Benzene Hexachloride and DDT. A third handles exhaust air from a cyclone which ventilates a mill that grinds concentrates such as Aldrin and Toxaphene. Cotton States estimates recovery of at least $65 worth of material a day, a potential annual saving of more than $16,000. Lift the blackout on your production profits. Investigate Dustube for your plant today. Write now for Bulletin No. 372.



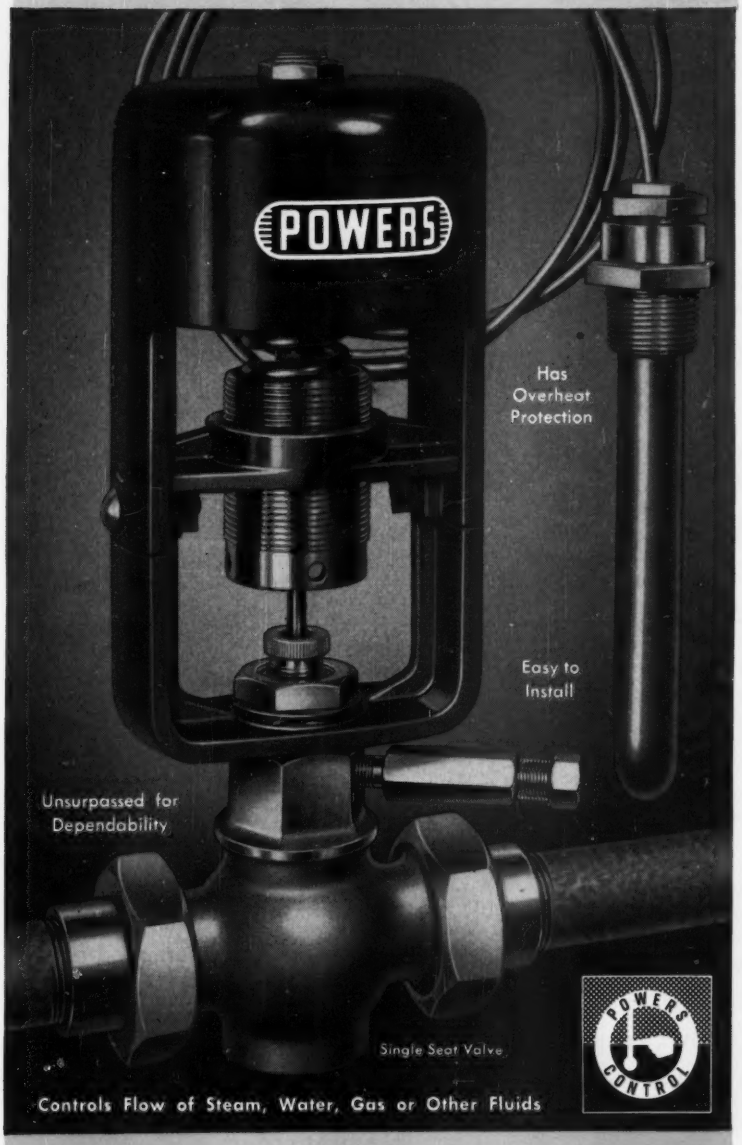
American® WHEELABRATOR®

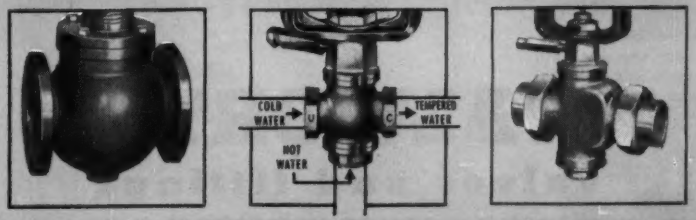
trail blazer of industrial progress

AMERICAN WHEELABRATOR & EQUIPMENT CORP., 347 S. Byrkit St., Mishawaka, Indiana

POWERS No. 11 Self-Operating TEMPERATURE REGULATOR

Automatically holds temperature constant at the right point. Prevents losses caused by wasteful OVER-heating.

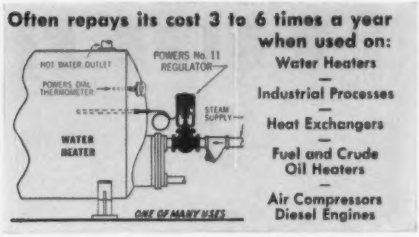




Various Valve Bodies and Inner Valves are available. Single and Double Seat Valves thru 2" have rugged bronze bodies with bronze union connections for quick, easy installation. Bulletin 329 gives information about all types.

(e33)

Why It Gives BETTER CONTROL and Saves More Money

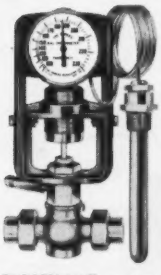


Often repays its cost 3 to 6 times a year when used on:

Water Heaters
—
Industrial Processes
—
Heat Exchangers
—
Fuel and Crude Oil Heaters
—
Air Compressors
Diesel Engines

ONLY POWERS No. 11 REGULATOR Offers ALL These Advantages

- **Simple, sturdy construction.** Materials used are corrosion resistant.
- **Powers bellows has 50% more power** than used in the majority of regulators. The heart of a self operating regulator is its bellows. Powers with its 50% greater effective area gives better control and its durable 2 ply bellows outlasts ordinary single ply bellows.
- **Valve stem lubricator** with silicone grease aids easy movement of highly polished stainless steel valve stem and reduces drying out of packing.
- **BETTER CONTROL** results from Powers powerful bellows and minimum of valve stem friction.
- **60°F. temperature ranges** available with accuracy of ±1°F. on some processes and 2 to 3°F. on others.
- **Rugged bronze valve bodies with bronze union connections,** for single and double seat valves thru 2", reduce installation time and labor. Larger sizes have flanged iron body valves.
- **Powers Nationwide Service and 24 Hour Delivery** in the U.S.A. are important time and money saving advantages.



- **Indicating Regulator** with easy to read 4" dial thermometer helps adjust the regulator and check temperature at the bulb. Various dials and ranges are available.

Right type and size of valve is important for good control. May we help you make the right selection? Benefit from POWERS more than 60 years experience with self-operating regulators.

Call our nearest office or write us direct for Bulletin 329.

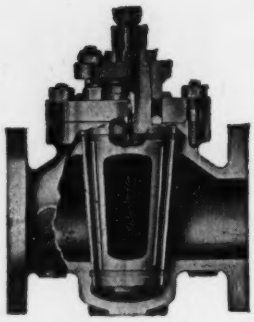
THE POWERS REGULATOR CO.

Skokie, Ill. | Offices in Chief Cities in U.S.A.
Canada and Mexico | See your phone book

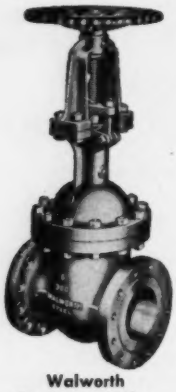
Automatic Temperature and Humidity Control

Established 1891

• VALVES
• PIPE FITTINGS



Walworth
Lubricated Plug Valve



Walworth
Steel Gate Valve

Walworth
Iron Body Gate Valve

Walworth
"500 Brinell" Bronze Globe Valve

Walworth
Iron Body Saddle Gate Valve

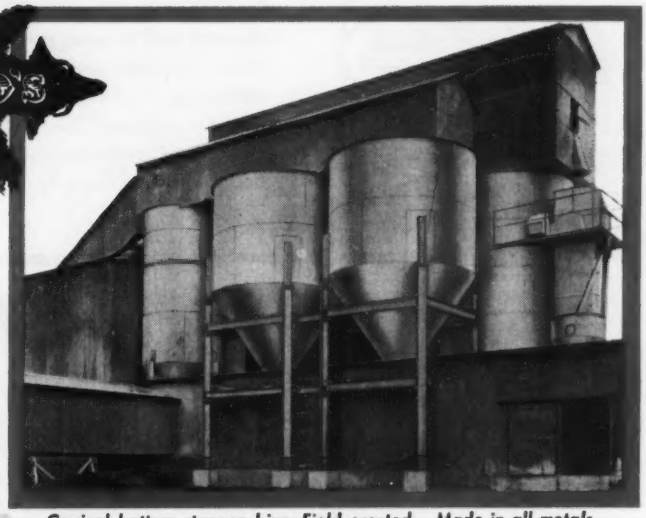
Walworth
Cast Steel Flanged Fittings

Walworth manufactures a *complete line* of valves and pipe fittings: all made to the highest standards of quality, both as to dimensional accuracy and metallurgical properties. In design, construction, and performance, Walworth products reflect more than a century of experience in the manufacture of quality valves and fittings.

Your Walworth distributor will give you full information on the *complete line* of Walworth steel, iron, and bronze, and special alloy valves and pipe fittings; also Walworth Lubricated Plug Valves, and Walseal* valves, fittings and flanges. Ask for this information today.

*Patented—Reg. U. S. Pat. Off.

WALWORTH
valves and fittings
60 EAST 42nd STREET, NEW YORK 17, N. Y.

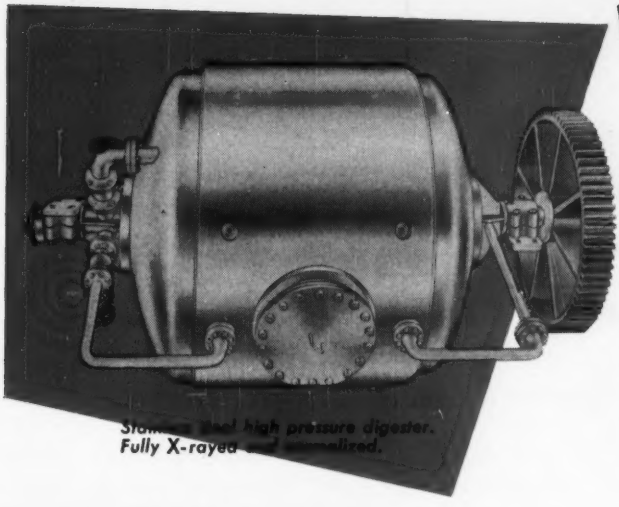


Conical bottom storage bins. Field erected. Made in all metals.

WHEN THE AMERICAN INDIANS BECAME UNITED STATES CITIZENS

Koven

WAS MAKING INDIVIDUALIZED CHEMICAL EQUIPMENT



Stainless steel high pressure digester. Fully X-rayed and enamelized.

With official recognition of the American Indians as citizens, this country entered a new era of peace and solidarity. During the same period, our expanding chemical industry was also taking great strides forward — aided and encouraged by such developments as KOVEN Individualized Chemical Equipment. Far-sighted chemical manufacturers quickly learned that dependable KOVEN equipment — designed and built to solve a specific problem — helped them achieve faster, more efficient production at lower cost. See how KOVEN's vast resources and over 70 years accumulated experience can help your plant toward speedier, more economical output. Call or write today for a consultation with a trained KOVEN representative. No obligation. Send for Bulletin #550.

Specialists in intricate fabrication using:

stainless steel
monel
nickel
aluminum
inconel
all clad materials

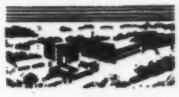
Fabrication to all A.S.M.E. Codes

X-Ray Inspection

FOR QUALITY CONTROL

KOVEN equipment in all metals and alloys include: High pressure vessels, extractors, mixers, stills, kettles, tanks, stacks, breechings. Shop and field erected storage tanks to 2 million gallons. High vacuum testing.

PLANTS:



Jersey City, N. J.

Dover, N. J.

L. O. KOVEN & BRO., INC.
154-A Ogden Ave., Jersey City 7, N. J.

KOVEN FOR INDIVIDUALIZED EQUIPMENT SINCE 1881.

"THE BRAND OF PROGRESS"

By Heat Exchanger Specialists

▲ SYNOPSIS OF AD #5: The purchasing department of Western Supply is charged with keeping the delicate balance between warehouse stocks of plate, tubes, channels, and flanges . . . and special materials requisitioned from outside sources. This balance is essential if maximum heat exchanger economy is to be achieved. The skill of Western's purchasers is proven in securing the high priced materials involved in alloy fabrication. Dollars saved through this experience are happily passed on to Western's customers.

FIGHTING HEAT EXCHANGER CORROSION

....With Experience in Special Metal Fabrication

Refining and chemical processing as we know them today have been made economically feasible by the development of heat transfer equipment.

Originally, heat exchanger design problems were simple but higher temperatures and pressures, combined with corrosive fluids have complicated the problem.

Today the experienced metallurgist and the trained welder form an indispensable team in Western Supply Company's heat exchanger plant. Corrosion and pitting may be controlled at the initial fabrication point through the skillful selection and fabrication of special metals.

Western has exerted great care in the initial selection and subsequent building of its technical staff. In addition it has equipped this staff with the latest welding and stress-relieving equipment. Western's experience in alloy fabrication dates back many years and includes working in such metals as . . . AISI Stainless Steels in the 300 series . . . High Chrome Irons . . . the Refiner's Alloys, the low chrome Moly Steels . . . Monel . . . Copper Silicon . . . Copper . . . Nickel. . . and Aluminum

For heat exchanger on corrosive stream . . . consult with Western Supply Company.

WESTERN HEAT EXCHANGERS

WESTERN SUPPLY COMPANY
P. O. BOX 1888 • TULSA, OKLAHOMA

HUDSON-RUSH COMPANY—753 Gladstone Blvd., Shreveport, La.
130 Casa Linda Plaza, Dallas 18, Texas
PROCESS INSTRUMENTS & EQUIP. CO.—North Bldg., Charleston, W. Va.
H. W. SEVERANCE—Marion E. Taylor Bldg., Louisville, Ky.

Question-Mark* FITTINGS

...A BARGAIN?

They could cost you your reputation!

***QUESTION-MARK FITTINGS**

Who is manufacturer?
How about his reputation?
What is his experience?
Does he give service?
Does he offer complete line?
Is stock available nearby?
Do fittings meet U. S. standards?
Are dimensions accurate?
Is circularity true?
Equal to strength of pipe?
Are fittings permanently marked with manufacturer's trademark and material designation?

YOU RUN THESE RISKS WITH THESE UNKNOWN PRODUCTS:

Failure in service... work stoppage... waste.
Impaired efficiency due to improper design.
Non-uniformity... wastes manhours.
Poor availability... costly in emergencies.
Short-line supply... handicaps selection.
Lack of service or responsibility.
Lack of engineering help on piping problems.
Lack of cost-cutting advancements.

Presented in the interests of piping safety and economy by

TUBE TURNS

A Division of National Cylinder Gas Company
LOUISVILLE 1, KENTUCKY

... Producer of **KNOWN VALUES**

Remember the trade-marks "tt" and "TUBE-TURN" are applicable only to products of TUBE TURNS.

Tube Turns' nearby complete stock SAVES YOUR PURCHASING TIME

Tube Turns' pioneering research GIVES YOU ADVANCED PRODUCTS

Tube Turns' engineering help GIVES YOU COST-CUTTING IDEAS

How to safeguard your piping and get *more for your money*

When you buy TUBE-TURN* Welding Fittings and Flanges, you get these known values:

TOP QUALITY AND SAFETY **RESPONSIBILITY** **PRECISE UNIFORMITY**
ENGINEERING SERVICE **WIDE SELECTION** **LOWEST-COST PERFORMANCE**
PROMPT DELIVERY **DESIGN ADVANCEMENTS**

They are made in U.S.A. and are identified by the trade marks shown above.

They meet ALL American Standard and Safety Code requirements.

They are engineered to give maximum strength and performance and in many cases exceed requirements by generous margins.

To get *more for your money* in welding fittings and flanges, specify the leading brand and buy from your trusted Tube Turns' Distributor.

The Leading Manufacturer of Welding Fittings and Flanges

TUBE TURNS LOUISVILLE 1, KENTUCKY

A Division of National Cylinder Gas Company

DISTRICT OFFICES: New York • Philadelphia • Pittsburgh • Cleveland • Detroit • Chicago • Kansas City • Denver
Los Angeles • San Francisco • Seattle • Atlanta • Tulsa • Houston • Dallas • Midland, Texas

*"TUBE-TURN" and "tt" Reg. U. S. Pat. Off.

Run SERVEL WATER CHILLERS on waste heat or waste steam!

Here's how to provide low-cost chilled water for your cooling needs

If you're letting waste heat or steam "go up in smoke," you're losing your cheapest source of chilled water.

Servel WATER CHILLERS utilize these waste products from any source to provide chilled water at *controlled* temperatures . . . chilled water you can use for industrial cooling, process cooling, or air conditioning in your plant.

These efficient Servel cooling units have no moving parts. They give you vibration-free operation and low upkeep. That's because Servel water chillers use an exclusive, modern absorption principle. No heavy-duty wiring required.

What's more, Servel water chillers are compact in size . . . and have low floor loading. That means you can put single or multiple installations in the most advantageous locations . . . on the roof, in the basement, or on any floor in between . . . even in a separate building.

Check these advantages against your cooling needs. Your Servel dealer will gladly supply details and engineering help. Or mail coupon today.

SERVEL WATER CHILLERS serve a wide variety of industries

1. Beverage Industry
2. Metal Plating Industry
3. Aluminum Industry
4. Steel Industry
5. Chemical Industry
6. Food Industry
7. Petroleum Industry
8. Dairy Industry
9. Printing Industry
10. Rubber Industry
11. Textile Industry
12. Wax Industry

Send coupon for details, now!

Servel

the name to watch for great advances in
AIR CONDITIONING ✓ REFRIGERATION

SERVEL, INC., Dept. CE-85, Evansville 20, Indiana

Please send me specifications and full information on Servel water chillers.

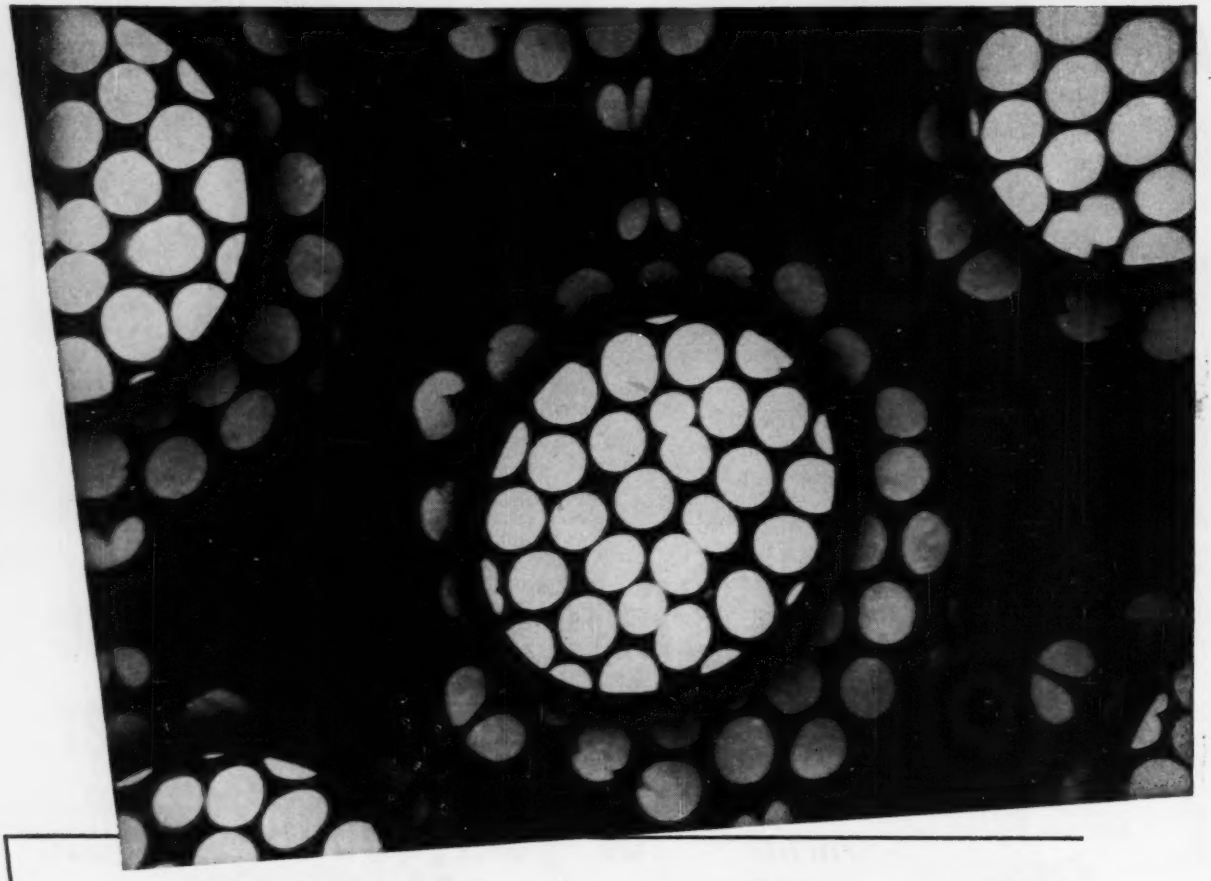
Name_____

Firm_____

Address_____

City_____ Zone_____

County_____ State_____



22,000 times as big as life

to show one why of Dicalite's "sharp" filtration

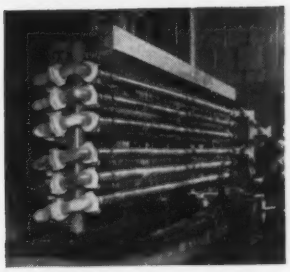
This electron micrograph of one of the more than 10,000 kinds of diatoms shows clearly the delicate, yet rigid, "skeleton" whose lace-like grid helps make diatomite such a superior filteraid. Imagine, for a moment, millions of these diatom frustules—needle-, disc- or boat-shaped—piling up strawpile fashion in the filter pre-coat or filtercake . . . then visualize bacteria or other sub-micron sized solids (enlarged to the same scale) coming against this barrier. Now, in your mind's eye, you can see clearly how the diatomite "grillwork" catches and holds all solids, while the fluid being filtered flows rapidly on through the billions of tiny channels which make up 90% of the filtercake's bulk.

Many processes and products in the chemical, industrial, food and pharmaceutical fields would be practically impossible without this "sharp" filtration provided by high-quality diatomaceous filteraids such as Dicalite. These Dicalite filteraids, processed under rigid controls from the highest quality diatomite, afford a complete range of uniform, sterile, chemically-inert products for the filtration of almost any liquid. They have provided the answers to many processing problems—they could well be the answer to yours. We will be glad to furnish full information, samples adapted to your requirements, or technical engineering aid if required.

DEPENDABLE SERVICE TO INDUSTRY 25 YEARS Dicalite 1930-1955

Dependable GLC GREAT LAKES Dicalite® DIATOMACEOUS MATERIALS

DICALITE DIVISION GREAT LAKES CARBON CORPORATION • 612 S. FLOWER ST., LOS ANGELES 17, CALIFORNIA



SCALE DEPOSITS which impede heat flow do not form on the hard, smooth inside surface of the PYREX pipe in this heat exchanger.

You can see what's happening in PYREX brand glass fractionating columns. No corrosion. No contamination.

This pipe would last **203** *years*

on a diet of hot hydrochloric acid

Handling corrosive fluids may be forcing you to pay more than your share of industry's $6,000,000,000 annual bill for the perpetual war against rust.

PYREX brand "Double-Tough" glass pipe can help you cut your corrosion losses.

This pipe carrying 5% hydrochloric acid at 212° F. loses only .0003 inch of its thickness in a year. At that rate it would take over 200 years to eat away 30% of the wall thickness. It would take over 600 years to eat completely through the pipe.

PYREX pipe not only resists eating away by hard-to-handle fluids. It's also easy to flush clean. Even sticky substances and organisms won't adhere to its hard, smooth surface. Its transparency is often important, too. You can see what's going on inside—spot trouble in the making.

You don't have to worry about breakage. PYREX pipe is called "Double-Tough" because all fittings and flanged ends are tempered. This makes them 2½ to 3 times stronger than ordinary glass.

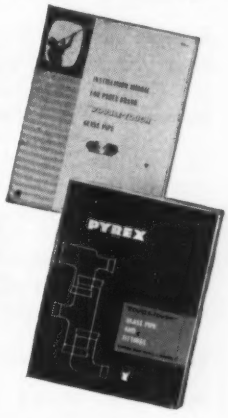
Easy to plumb

Your own men will find no difficult problems in installing and maintaining PYREX pipe. We maintain balanced stocks ranging in size from 1" to 6" I.D., including fittings to match the needs of most layout requirements and adapters for hooking PYREX lines in with other plant equipment.

FREE BOOKLETS: Send the coupon or write for copies.

This illustrated "Installation Manual" describes the simple procedures involved in laying out and plumbing PYREX brand glass pipe.

This catalog describes the full line of PYREX pipe and fittings, including spacers, adjustable joints, traps, and adapter connections.



CORNING GLASS WORKS
18 CRYSTAL ST.
CORNING, N. Y.

Corning means research in Glass

CORNING GLASS WORKS, 18 Crystal St., Corning, N. Y.
Please send me a copy of the PYREX pipe Installation Manual ☐ and a copy of the PYREX pipe Catalog ☐. I would also like more information on heat exchangers ☐ and fractionating columns ☐.

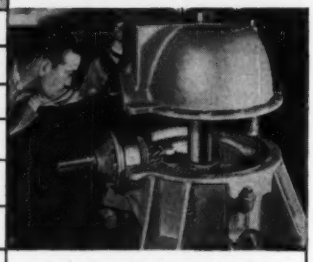
Name..... Title.....
Company.....
Address.....
City..... Zone..... State.....

FLUOR -WESTERN SPEED REDUCERS

add years to the mechanical life of cooling towers

Gear reducers which drive the fans in induced draft cooling tower service are located in the exhaust stream and are constantly exposed to the hot, humid and often corrosive vapors coming up through the tower. Gear boxes must be specially designed to withstand corrosion, and operate efficiently and economically for the life of the tower. The built-in superiority of the Fluor-Western power transmission unit is shown in the chart below. The Fluor unit is compared with five competing makes:

The bell-shaped housing on Fluor-Western Speed Reducers is low, wide, and offers a good sturdy support for fan.



Each Fluor-Western Speed Reducer is thoroughly tested for noise level and horsepower rating before leaving the factory.

	FLUOR	A	B	C	D	E
1. Case-hardened spiral gear	yes	yes	yes	yes	no	yes
2. Ratings based on 1.5 AMGA service factor	yes	no	yes	yes	no	yes
3. Straddle mounted pinion gear	yes	no	no	yes	yes	no
4. Webless-type ring gear	yes	yes	no	yes	no	yes
5. B-10 bearing life (in hours)	80,000 to 2,000,000	50,000	20,000	80,000 to 100,000		5,000
6. Condensate trap	yes	no	yes	yes	no	yes
7. Double neoprene seals (input shaft)	yes	no	no	no	no	no
8. Two oil-fill elbows	yes	no	no	no	no	no
9. Efficiency	98%	98%	98%	98%	90-95%	98%

EXPLANATION OF CHART

1. Over the years, case-hardened spiral bevel gears have proved to be far superior to worm gears or flame-hardened bevel gears.

2. The Fluor-Western Speed Reducer is designed and rated in accordance with the applicable standards of the American Gear Manufacturers' Assn. and utilizes a minimum service factor of 1.5 for continuous service.

3. The Fluor-Western pinion is straddle-mounted on heavy-duty bearings. Uniform tooth contact, quieter operation, minimum deflection are the advantages.

4. Deflection tests on ring gears prove conclusively that webless ring gears which utilize a maximum diameter hub are much more rigid than web-mounted gears.

5. Most gear failures are traced to bearing failure. The majority of bearings in the Fluor-Western Speed Reducer have a B-10 life in excess of 100,000 hours. At certain ratios and speeds bearing life can be considered infinite.

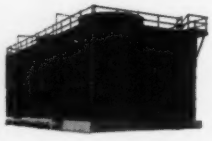
6. A condensate trap collects entrained water inside the gear unit caused by condensation, thus protecting the lower bearing from improper lubrication.

7. Two Neoprene seals mounted back to back on the input shaft, with grease between (to keep foreign matter out and oil in), are found only on the Fluor-Western unit.

8. Only Fluor-Western units have the servicing convenience of two oil-fill elbows; one is piped outside the fan stack for easy filling, the other provides a positive check for proper oil level.

9. Efficiency ratings are based on actual gear mesh loss. Fluor-Western spiral bevel gears average around 1% to 2% loss while competitive worm gears show a loss of 5% or greater.

A COOLING TOWER EVERY 3 DAYS



In the past decade (1944 through 1954) Fluor has built 1,218 induced draft cooling towers throughout the world—**an average of one new tower every three days.** The total number of cells in these towers adds up to 3,138 which represents 3,138 individual gear reducers ranging in sizes from 15 to 100 horsepower ratings. The extra long gear and bearing life of Fluor-Western Speed Reducers is an important factor in the overwhelming preference for Fluor Cooling Towers. The Bulletin, "Cooling Water for Industry," will be mailed on request.

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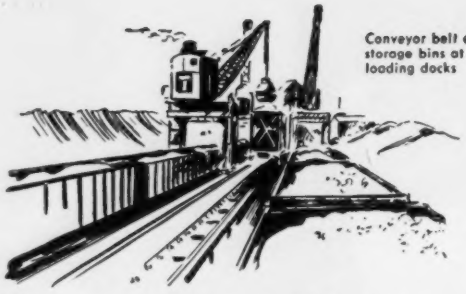
Conveyor belt and storage bins at loading docks

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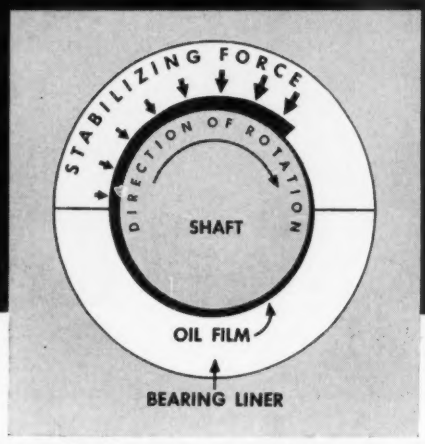
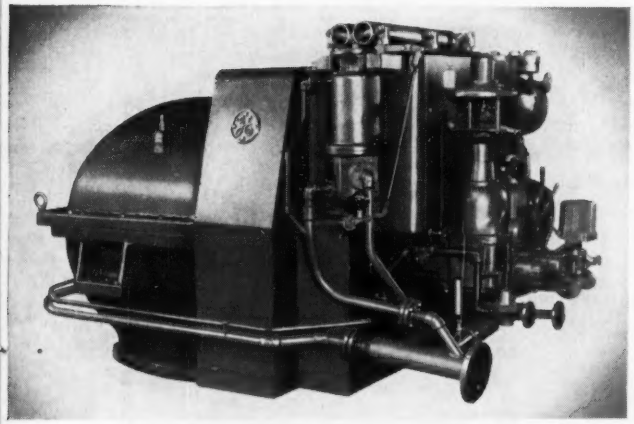


OIL DAM IN UPPER BEARING HALF, located at pencil point, restricts oil flow around shaft, building up a pressure pad as shown at left. As turbine gains speed, oil pressure increases and forces shaft down into ample surfaces of lower bearing liner, above right, assuring stability at high speed.

Large pressure-pad bearings add years of life to G-E high-speed turbines



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To provide longer, more reliable service, all G-E high-speed turbines incorporate large pressure-pad bearings. The generous surfaces of the bearings assure low unit loading for ample lubrication and minimum wear during start-up.

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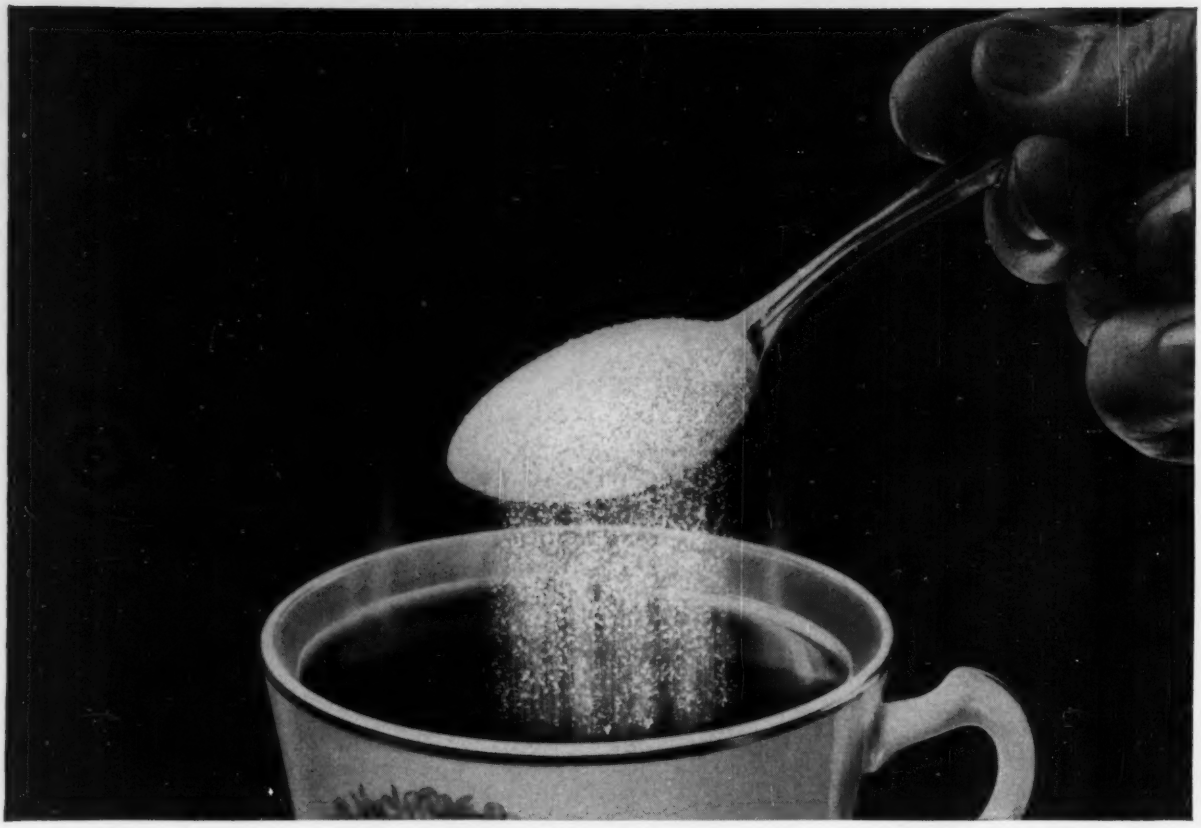

M-m-m! Sparkling pure white sugar delights eye and palate. But it's not easy to produce. Natural impurities and corrosion products must be eliminated. And that is where Inco Nickel comes in. It resists corrosion.

How Inco Nickel helps make sugar pure white

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Take juice evaporators. Operated continuously, they scale up . . . must be boiled out with caustic, then washed with 2½% hydrochloric acid. But with nickel and Nickel-Clad Steel, they stand up indefinitely.

For product purity . . . for long equipment life . . . Inco-Nickel is nearly always a good bet. It resists most chemicals well. Maybe it would prove valuable to you. Inco's Corrosion Engineering Section would gladly look into it for you. Just write or call.

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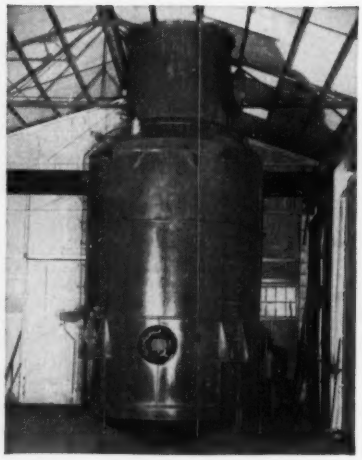
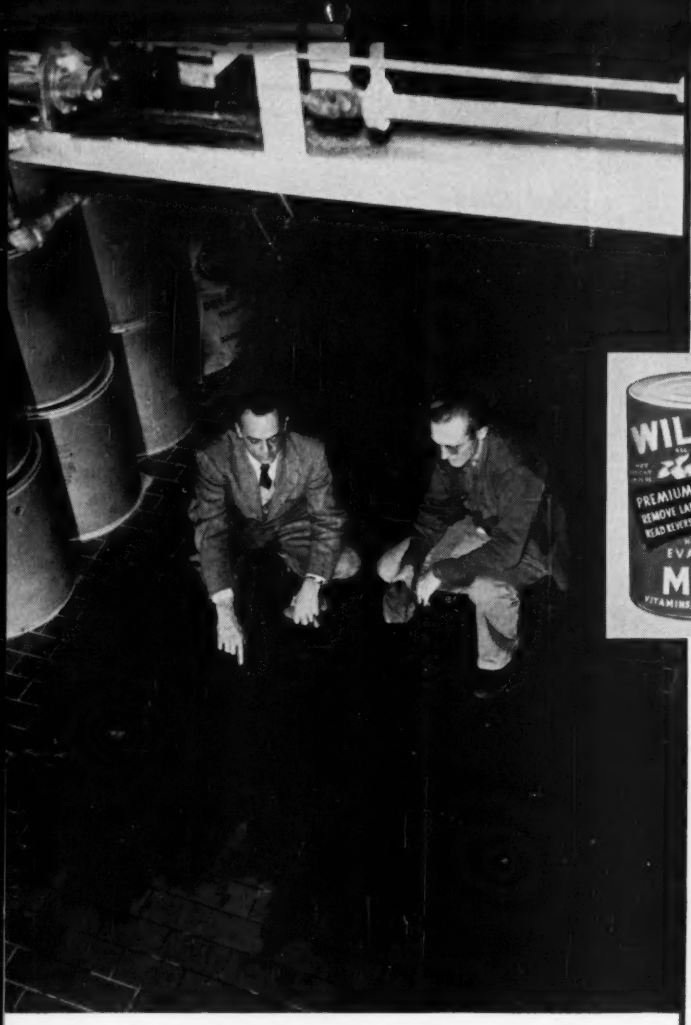


Inco-Nickel protects product purity in this vacuum syrup pan made by Nadler Foundry and Machine Company, Plaquemine, Louisiana. For more information on this and similar types of concentrators, write the Nadler Company direct.

INCO TRADE MARK **Nickel Alloys**

STANODRIP *Oil whips lubrication problem at Wilson Milk Company*



MANAGEMENT OF THE Wilson Milk Company plant, Sheridan, Indiana, had a serious lubrication problem. STANODRIP Oil solved it.

In overhead bin loaders, hydraulic rams push powdered milk along conveyor chute to weighing machine. Leakage of lubricant from rams on the floor below caused a sanitary and safety problem. Packings were replaced every two months but leakage often recurred as early as two weeks after packing replacement.

Then Mr. Taylor Wiham, Assistant Superintendent, called in John Pirtle, Standard Oil Industrial lubrication specialist. Mr. Wiham asked about STANODRIP Oil and its possible use as a solution to this lubrication problem. Decision was made to convert to STANODRIP Oil No. 29. Old oil was removed, packings replaced and STANODRIP installed.

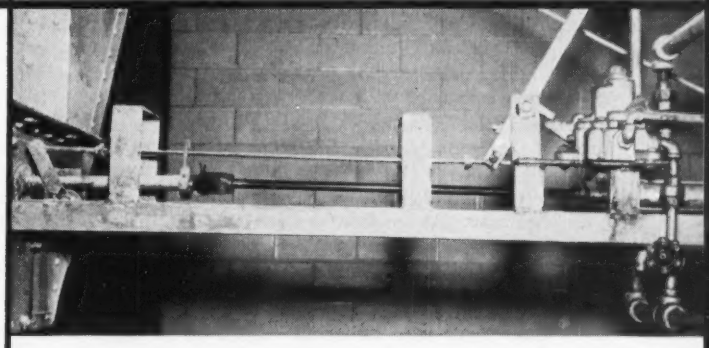
In more than 8 months since installation of STANODRIP Oil, there has been no leakage, no packing replacement. Hydraulic rams are lubricated without oil dripping or creeping.

Maybe STANODRIP Oil can serve you as it has Wilson Milk Company. Find out. In the Midwest, call your nearby Standard Oil lubrication specialist. Or contact Standard Oil Company, 910 South Michigan Avenue, Chicago 80, Illinois.

Taylor Wiham, Wilson Milk Company (right), and John Pirtle, Standard Oil lubrication specialist, inspect oil stain on otherwise spotless floor, the result of previous oil leakage from overhead hydraulic bin loader. Leakage has been eliminated through use of STANODRIP Oil No. 29. Helping customers with lubrication problems is something John Pirtle is well equipped for. John has an engineering degree from Rose Polytechnic Institute, has completed Standard Sales Engineering School and has a number of years of field technical service experience. Customers find this experience and training pay off *for them.*

STANDARD

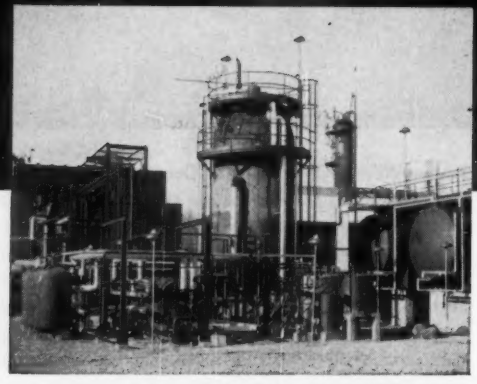
STANDARD OIL COMPANY
(Indiana)



Three bin loaders like the one shown here dripped oil until converted to STANODRIP. No leaks have occurred in 8 months since. Previously, packings were replaced every two months. Even then leakage often recurred as early as two weeks after repacking.

problems in water-conditioning . . .

VERSATILITY



SPENCER CHEMICAL COMPANY INSTALLS COCHRANE HOT LIME ZEOLITE

Photograph shows Cochrane Hot Lime Zeolite Softener installed in the new multi-million dollar Spencer Chemical Company plant, at Vicksburg, Miss. Capacity of the unit is 14,000 gph.

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Cochrane Corporation designs and manufactures complete lines of deaeration, ion exchange, precipitation, and water conditioning equipment . . . Pioneers of the Hot Process, Cochrane today continues to lead in Hot Lime Zeolite. Consult Cochrane First!

For further information on Cochrane Hot Lime Zeolite Softeners, write for Publication 4801.

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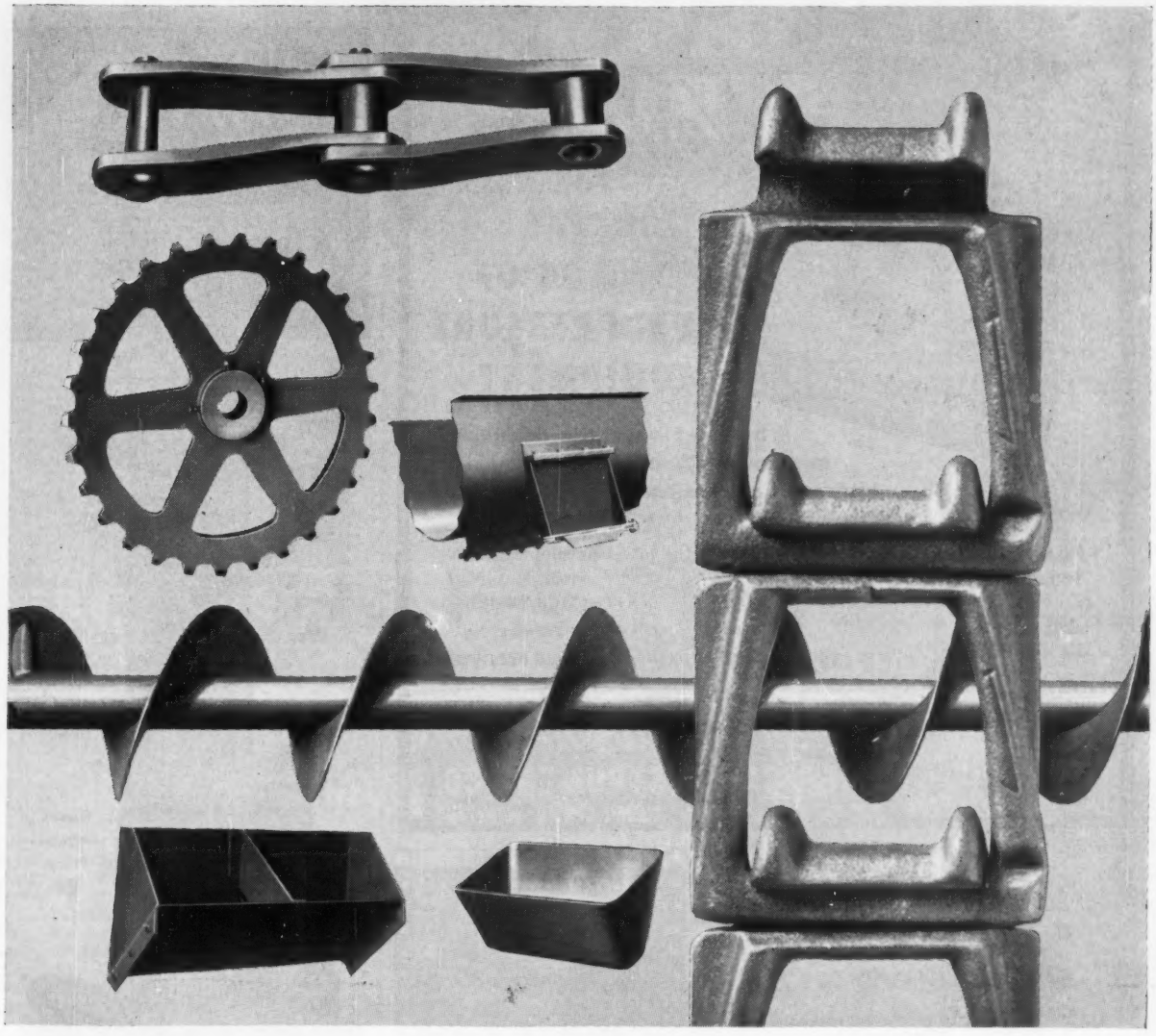

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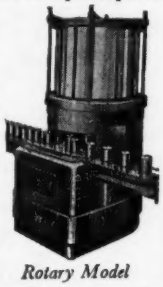

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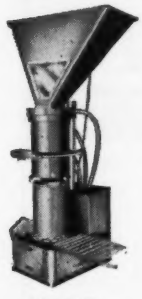

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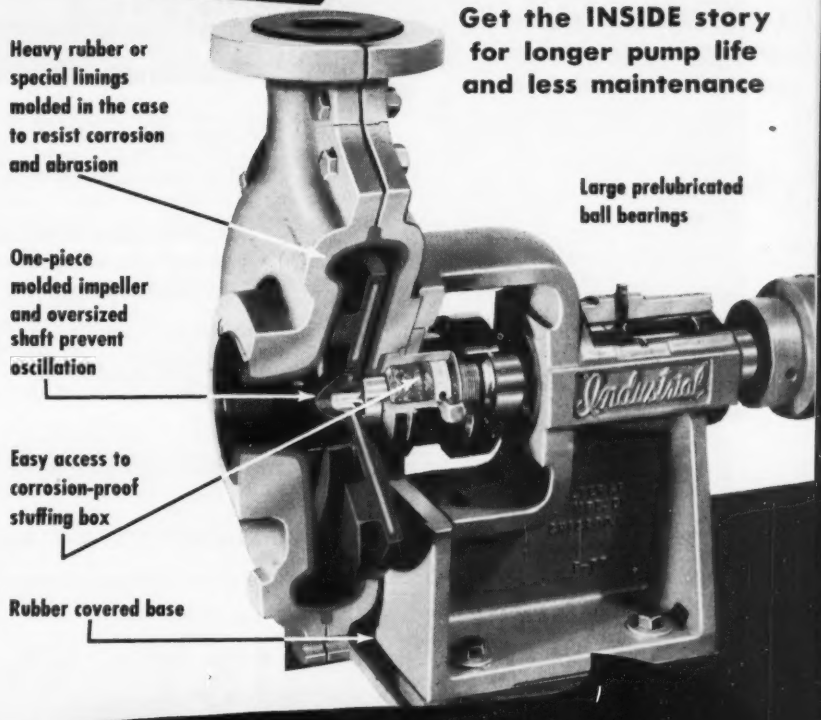
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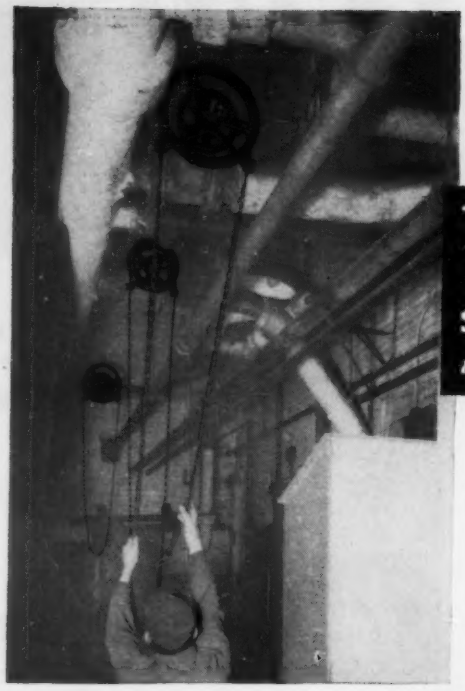

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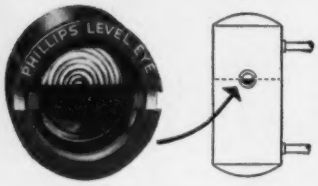

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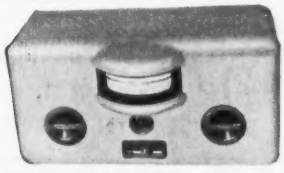
Voltage	1 millivolt per °C
Maximum pressure	75 PSI
Dimensions	6-3/16 x 2⅛ x 2¾
Weight	15 oz.



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SPECIFICATIONS

Weight	Approx. 21 pounds
Dimensions	8¼" x 9" x 17"
Maximum pressure	50 PSI
Range full scale	300, 600, 1500, 3000 watts
Meter sensitivity	1.5 mv
Thermopile sensitivity	1 mv/°C
Controls	Range switch, Calibrating valve, Calibrating potentiometers
Fittings	For ¼" x ⅜" plastic tubing

Other equipment for use in power measurements and specific equipment for microwave power measurement set-up.

- Model 5801 Calorimeter—Range 60, 150, 300, 600 watts.
- Model 3701 Water load calibrator heater.
- Model 4105 X Band Water load • 1000 watts CW 300 Kw. peak • Less than 1.2 VSWR over 7000/10000 mc.
- Model 5500/5501 Variable phase standing wave introducer at X band.

Let us send you full specifications on these tools for power measurement, or send for our complete catalogue.

- Glass Working Lathes, equipment.
- High Vacuum Pump and Gauge.
- Hydrogen Bell Jars.
- Vacuum Tube Laboratory Equipment.
- Spot Welder and Timers.

3237

Litton Engineering Laboratories
Grass Valley, California • P. O. Box 949

New Type Eppenbach COLLOID MILL

Featuring

Large Tangential Outlet which prevents back pressure and allows increased output capacity
Both Rotor and Stator are Interchangeable Stellite rings and stones—facilitating replacement when required.
Sanitary fittings throughout.
Illustration shows large production Mill Model QV-11 with 15 H.P. motor

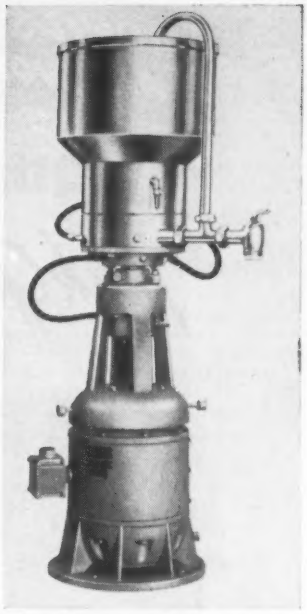
Eppenbach Colloid Mills operate at speeds approaching the theoretical minimum required for true wet micro grinding—shaft speeds up to 10,000 r.p.m. depending on size and type of mill.

These Mills assure uniform grind through advanced engineering features including (1) Improved ball bearings which center the shaft and minimize lateral whip and (2) Invar shafting with zero coefficient of heat expansion.

All Mills can be made with pressure feeds and jacketed hoppers.

Consult our Sales Department with your technical problems.

Write for literature describing *Eppenbach* equipment —now manufactured and sold by:



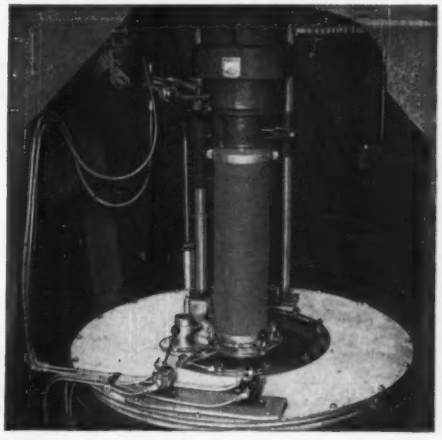
Direct-drive model shown operates at 3500 RPM. Higher speeds can be furnished. Colloid Mills made in all sizes from ¼ H.P. model laboratory size to 50 H.P. model.

ADMIRAL TOOL & MFG. CO., INC.

45-10 VERNON BOULEVARD
LONG ISLAND CITY, 1 N. Y.

Fletcher

PNEUMATIC UNLOADER FOR CENTRIFUGALS



The latest Fletcher development in its line of modern high-speed centrifugals is the use of pneumatic controls to greatly ease and simplify unloading operation. By this means the back-breaking and fatiguing hand cranking operation is eliminated, and the operator's efficiency is materially increased. The scraper is at all times under complete control.

The air-operated unloader also simplifies the design of a fume hood for noxious gases.

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LIQUIDOMETER

Tank Gauge

- FOR GAUGING LIQUIDS OF ALL KINDS
- 100% AUTOMATIC
- APPROVED BY UNDERWRITERS' LABORATORIES

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THE LIQUIDOMETER CORP.
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You'll Find Metalweld Services A Sound Investment, Not An Expense!

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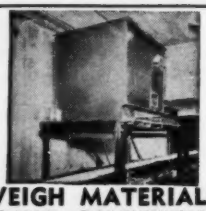

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ACID-ALKALI-PROOF CONSTRUCTION
of processing & storage tanks & flooring.

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ANY LIQUID
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EACH ISSUE

THIS WHERE TO BUY SECTION supplements other advertising in this issue with these additional announcements of products and services essential to efficient and economical operation in the process industries.

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PROCESS DEVELOPMENT & PILOT PLANT WORK
PLANT CONSTRUCTION & ERECTION
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Let them save your time by bringing their broad experience in their specialty to bear on your problems.

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Evaporation, crystallization, and Heat Transfer; Complete plants for salt and caustic soda; Complete Dowtherm installations.
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MU. 6-4712

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GRamercy 3-6400

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Design - Construction - Reports - Appraisals
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EMPLOYMENT OPPORTUNITIES

The Advertisements in this section include all employment opportunities—executive, management, technical, selling, office, skilled, manual, etc.

Positions Vacant	Civil Service Opportunities	Employment Agencies
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Send NEW ADS to CHEMICAL ENGINEERING, 330 W. 42nd St., N. Y. 36, N. Y., for September issue closing August 3rd.

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Manufacturing (Refining) Department
is looking for

CHEMICAL ENGINEERS, CHEMISTS, and MECHANICAL ENGINEERS

with one to five years experience in petroleum refining or related activities
for staff work primarily in Cleveland, Ohio.
Possible employment in Toledo, Lima, or Cincinnati, also.

Applicant should have the following educational background and industrial experience:

Chemical Engineers: B.S. or higher degree and experience in development, pilot plant operation, process design, process trouble shooting, refinery process engineering, economic studies, or related work background.

Chemists: B.S. or higher degree and experience in product and process research or development.

Mechanical Engineers: B.S. or M.S. degree and experience in process equipment construction, design, inspection, or maintenance, petroleum product testing and field evaluation, or related work background.

Age range 22 - 32

Salaries commensurate with experience and level in organization. Advance on merit basis.

If you can qualify and are looking for a permanent job with a growing but secure midwest company, write, giving full information on education, industrial experience, military experience, and personal data to E. G. Glass, Jr., 1737 Midland Building, Cleveland 15, Ohio.

SALES ENGINEERS

We have openings for Sales Engineers in Detroit, Cleveland, and New York

We manufacture industrial instruments and have a complete line of Mechanical and Electronic Recorder & Recorder Controllers

Our resources are second largest in the industrial instrument field and Management is desirous of expanding sales. Excellent opportunities for graduates in Electrical, Mechanical and Chemical Engineering

P-6486, Chemical Engineering
330 W. 42nd St., New York 36, N. Y.

South AMERICAN Positions Open

MECHANICAL ENGINEER with several years experience in actual supervision of large shops comprising machine shops, plate and welding shops, iron, steel and brass foundries.

DESIGN DRAFTSMAN for Mechanical Department's Engineering Office.

TRAINMASTER to cordinate all sections of Operating Division, including supervision of train crews, dispatchers, yard and station forces, car distribution, etc.

MAINTENANCE ENGINEER (OR MILL MASTER MECHANIC)—graduate Mechanical Engineer to take charge of all mechanical maintenance and repairs for all equipment throughout Concentrator Plant and operations. Should have good understanding of metallurgical processes and equipment.

FIELD ELECTRICAL ENGINEER with thorough knowledge of characteristics and applications of power equipment for industrial use.

GENERAL SMELTER FOREMAN AND ASSISTANT GENERAL SMELTER FORMAN with good suitable technical educations and all around smelter operating experience. Should have executive ability and be able to assume responsibility.

SMELTER METALLURGIST AND ASSISTANT SMELTER METALLURGIST to work on metallurgical problems and smelter operations.

Large Copper Company Chile, South America. 3-year contract. Transportation both ways and salary while traveling paid by Company. Good opportunities. In reply give complete details.

P-6894, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

UTILITIES ENGINEER
(Foreign Service)

Chemical Engineer with minimum 5 years' experience in operational & maintenance phases of steam electric power plants.

Write giving full particulars regarding personal history and work experience. Please include telephone number.

Recruiting Supervisor, Box 46

ARABIAN AMERICAN OIL COMPANY
505 PARK AVENUE
NEW YORK 22, NEW YORK

CHEMICAL ENGINEERS

An active, confidential service! Interview at your convenience.
Call, write or wire
GLADYS HUNTING (Consultant)
DRAKE PERSONNEL, INC.
220 So. State St. Rm. 628 Chicago 4, Ill.
HArrison 7-8600

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B.S. to Ph.D. Beginners—Experienced
We place EXCLUSIVELY with Chemical Companies
Call—Come In—Send 5 résumés
SELECTIVE PLACEMENT EMPLOYMENT AGENCY
17 William Street Newark, N. J.
C. A. Reed Jr., M.Sc. S. Goodman, M.Sc.

SANITARY ENGINEER

Opportunity available for Sanitary Engineer in an expanding pulp and paper mill located in the Middle Atlantic States. Age 25-35 years. Require man experienced in Paper Mill wastes, Paper Mill stream pollution and Paper Mill Water purification. No other experience will be given consideration. Good salary and advancement. Send resume of educational background and industrial experience. All replies confidential.

P-6998, Chemical Engineering
330 W. 42 St., New York 36, N. Y.

IDEA MAN
CHEMIST OR CHEM. ENGR.

wanted with idea for NEW product in Drug or Hospital field. Full financing + salary + an equity. One of many opportunities.

CONTACT - Bob Poore
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Tel. WAbash 2-1884

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REG. U.S. PAT. OFF.

Better Things for Better Living
...through Chemistry

challenge
and
responsibility

In These SIX LONG-RANGE CAREER POSITIONS
in
SPECIALIZED AREAS OF CHEMICAL ENGINEERING

DuPont's Engineering Service Division provides consulting service and technical assistance to production, maintenance, design, research, and construction groups in the company. The objectives of the Division are to assist other company units in improving plant efficiency and product quality, in reducing investment and operating cost, and in increasing capacity.

Six openings are immediately available for experienced graduate chemical engineers to provide consulting service to operating plants in the following specialized technical areas:

AGITATION AND MIXING EQUIPMENT

This opening requires five years general industrial experience and a thorough knowledge of theory and practice in the field of agitation.

Duties will include the determination of agitation requirements for chemical reaction, heat and mass transfer, dispersion, blending, and other operations.

General responsibilities in the above areas include equipment specification and design, trouble-shooting, and consultation service.

NON-FERROUS METALLURGY

The most qualified candidate will be a graduate metallurgist or metallurgical engineer whose experience with non-ferrous metals and alloys qualifies him for challenging and responsible consulting service in connection with the construction of chemical processing equipment and facilities.

The successful applicant will initiate and direct studies to insure maximum use of non-ferrous metals and alloys, recommending their selection and use in terms of cost, availability, and life expectancy. Duties will include consulting and specification in welding, joining, and fabricating.

PUMPS AND FLUID FLOW

Desired background will include substantial industrial experience, of which at least one year should be in research, design, consulting, application, or specification of pumps and compressors.

Responsibilities will involve equipment selection, trouble-shooting, and consultation on fluid flow and mechanical design aspects of pumps, jets, and compressors.

PLASTICS AND PROTECTIVE COATINGS

The successful applicant will be a graduate engineer who is qualified by education and experience to assume responsibility in providing consulting service in the fields of plastics utilization, protective coatings, and corrosion barriers used in the construction of chemical processing equipment and facilities.

Duties will include: the initiation and direction of studies to insure maximum use of these materials and to determine property data requirements for engineering applications; and the development of specifications for procurement, design, construction, maintenance, and utilization.

PETROCHEMICAL PROCESS & EQUIPMENT

Position requires 5 to 10 years industrial experience in the fields of research and development on petrochemical processes and equipment.

Principal duties will be to provide engineering consultation to research, development, design, and production groups on petrochemical processes and equipment, to make economic process evaluations, to recommend or specify equipment and process for pilot and plant scale operations.

DRYING AND DRYING EQUIPMENT

Desired qualifications will include substantial experience in the practical aspects of drying particulate solids and sheet and fibrous materials. A sound knowledge of the fundamentals of heat and mass transfer is important.

The duties of the position will require a broad and detailed knowledge of mechanical drying equipment and their applications. The position requires a high level of creativeness and skill in evolving unorthodox solutions to practical problems in drying.

Please send complete resume, including details of education and experience, to:

Mr. J. C. COSTELLO, JR.
Personnel Section, Engineering Dept.

E. I. du Pont de Nemours & Co., Inc.
WILMINGTON 98, DELAWARE

CHEMICAL ENGINEERS

Excellent opportunities open to men who are qualified for Process Development, Production and/or Engineering Design fields. The work is related to the expanding operations of a long established midwestern chemical company and will provide opportunities at most levels of experience.

Applicants must be eligible for security clearance by AEC, and should submit complete resume of personal data, education, previous experience, salary desired and references. All replies will be treated in confidence.

P-5551, Chemical Engineering
520 No. Michigan Ave., Chicago 11, Ill.

ESTIMATOR

Large midwest engineering and construction firm has opening for man with prior estimating experience in the gas, oil and petroleum fields.

This man must be able to assume complete responsibility for take-off and setting up an estimate. Ability to do preliminary layout work desirable.

In reply, furnish a detailed resume of your education, experience, references and salary requirements. Address

P6876 Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

CHEMICAL ENGINEER

Recent graduate or up to two years of pilot plant experience for research and development work. Work involves the development of new organic and inorganic processes as well as improvements in existing processes. Please give complete details of experience and salary requirement to

Manager, Personnel Planning
Wyandotte Chemicals Corporation
Wyandotte, Michigan

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Salaried Positions $5,000 to $35,000. We offer the original personal employment service (established 45 years). Procedure of highest ethical standards is individualized to your personal requirements. Identity covered, present position protected. Ask for particulars. R. W. Bixby, Inc., 653 Brisbane Bldg., Buffalo 3, N. Y.

MANUFACTURERS REPRESENTATIVE
SELLING OPPORTUNITY WANTED

Manufacturers agent calling on chemical paint petroleum food plastics industries in Chicago-Milwaukee district wants line. Chemical engineer Illinois registered professional engineer.

RA-6713 Chemical Engineering
520 N. Michigan Ave., Chicago 11, Ill.

SEARCHLIGHT SECTION

(Classified Advertising)

BUSINESS OPPORTUNITIES — EQUIPMENT - USED or RESALE

REPLIES (Box No.): Address to office nearest you
NEW YORK: 330 W. 42nd St. (36)
CHICAGO: 520 N. Michigan Ave. (11)
SAN FRANCISCO: 68 Post St. (4)

POSITIONS VACANT

Wanted: Graduate Engineers, preferably chemical for both headquarters, consulting and field sales work. For sales, should have 3 or more years successful record. For consulting, young men preferred so that our business can be taught to them and then can move up in subsequent years. Write P-5460, Chemical Engineering.

Large specialty paper mill in Northern Wisconsin has an immediate opening with good advancement possibilities, in its main mill laboratory, for an aggressive chemist or chemical engineer. Age 23-35 with previous experience in pulp, paper, or converting desirable, but not mandatory. Please include training, experience, and salary requirements in your reply. P-7048, Chemical Engineering.

Wanted: Young chemist or chemical engineer with or without previous paper mill experience to assist chief chemist in the main laboratory of a large integrated fine paper mill located in Northern Wisconsin. Please give a complete resume in first letter, including salary requirements. P-6864, Chemical Engineering.

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Manufacturers Representatives available to sell line of forge steel fittings and valves, diaphragm valves, safety and relief valves, globe and angle valves to wholesalers and major consumers for northern N. J. terr. Norse Engineering Co. 20 Race St. North Plainfield, N. J.

POSITION WANTED

Plant Manager 34, B.Ch.E., 13 years experience, present full charge 100 man plant, increased responsibility small or medium company. PW-6934, Chemical Engineering .

Contest

Three awards—$500, $250 and $100 for best original, unpublished papers on tall oil. Write for information and entry blanks. Tall Oil Division, Pulp Chemicals Association, 122 East 42nd Street, New York 17, N. Y.

AVAILABLE
WANTED

CUSTOM REFINING FACILITIES . . .
- Complete Distillation Service • Distillations
- Extractions • Fractionations Drum Lots—Tank Cars
- All Types of Crude Mixtures
- By-Products, Residues, Wastes
- Contaminated Solvents

Truland CHEMICAL & ENGINEERING CO., Inc.
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FOR SALE
BELOW MARKET PRICES
PRIME—GUARANTEED

Carbon Tetrachloride, 35,000 lbs. net in 55 gal. drums 700 lbs. ea.
Chloroform, USP 7,476 lbs. in one lb. bottles, commercial Portable Centrifuge, 1/3 H.P., International #1. Excellent Condition.

ARRO EQUIPMENT COMPANY
Phone 4-7443 P.O. Box 256 Knoxville, Tennessee

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PROCESS EQUIPMENT
For Laboratory and Production
HIGH SPEED STONE MILLS
PEBBLE MILLS; Large Selection
COLLOID AND ROLLER MILLS, AGITATORS MIXERS, CRUSHERS, FILTERS, STRAINERS CENTRIFUGES, PUMPS, TANKS, KETTLES HOISTS, EX. PR. LIGHTS AND GENERAL PAINT FACTORY SUPPLIES OF ALL TYPES
SPOT LOTS OF RAW MATERIALS TO BUY OR SELL— *TRY*
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PH: ARmitage 6-8050

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All Kinds of Oil Refinery and Chemical Equipment, also Tanks
Write — Wire — Phone
Weinstein Co., Div. of Surplus & Salvage Co., Inc.
610 West 8th Street Jamestown, New York

HIGH PRESSURE COMPRESSOR
Like new skid mounted portable high pressure unit consisting of 1—Clark Gas Engine-Compressor, 1—Clarkooler and 1—Starting Air Compressor

Gas Engine—4 cyl, 2 cycle, 150 HP @ 600 RPM
Compressor—2 stage, 38.5 MSCF/hr @ 2300 psig discharge pressure
Clarkooler—forced draft, Model 141
Starting Air Compressor—Curtis Mfg Co. 4 cy, 5.25 HP @ 2200 RPM, B&S gasoline eng., capacity—12 cf/min

Purchasing Department
WASHINGTON GAS LIGHT COMPANY
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Chemicals—Dyes—Drugs
Colors—Pigments—Oils—Waxes
By-Products—Wastes—Equipment
CHEMICAL SERVICE CORP.
80-04 Beaver St. New York 5, NY

Get wise to good buys...

BUY BRILL—IT FILLS THE BILL

See Additional Listings on Page 386

DRYERS

1—Vulcan 8'x125' Rotary Kiln ¾".
2—Cummer 5'x40', 5'x30' Rotary.
1—Vulcan 4½'x50' Rotary.
1—Link Belt 6'4"x24' steel Roto-Louvre. Dryer Heresite coated.
1—Link Belt 3'10"x12' steel Roto-Louvre Dryer.
1—Devine #27 double door Vacuum Shelf, 17—59"x78" shelves.
1—Stokes Vacuum Shelf Dryer #138-H-10 44'x40" shelves.
2—Struthers Wells 5'x15' nickel clad Rotary Vacuum.
1—Devine 5'x10' steel Rotating Vacuum.
1—Stokes 30"x8', 3'x15' Rotating Vacuum.
4—Buflovak Double Drum 32"x100", 36"x84", 32"x72", 32"x52".
2—Buflovak 6' and 3' dia. Crystallizers.

FILTERS

3—Oliver Monel 8'x10', 3'x2' Rotary.
1—Oliver S.S. 8'x6' Rotary Vac.
2—Oliver 5'3"x6' Rotary Vac.
2—Sweetland #12—72, 36 leaves.
2—Sweetland #3 all S/S.
2—Sweetland #5, #7.
1—Niagara 110 sq. ft. S/S.
1—Sparkler # 33-S-17, steel.
3—Shriver 36" P&F 42 chambers.
4—Shriver 30" P&F 30 chambers.
8—Sperry 24" P&F 16 chambers.
2—Sperry Aluminum 30" and 24" P&F.
1—Sperry 36" P&F, heresite.
12—Filter Press Skeletons, all sizes.

SCREENS

4—#82 Rotex double deck 40"x120".
1—Patterson single deck 40"x84" S/S.
1—#23 Rotex three deck 20"x80".
3—Tyler Hummer, 4'x10', 4'x5'.

CENTRIFUGALS

1—Bird 40" Suspended, 304 S/S.
1—Bird 40" Suspended, rubber.
3—Tolhurst 40", 32" Suspended, steel.
1—AT&M 36" rubber covered.
1—AT&M 36" Suspended, steel.
1—Fletcher 30" Suspended, steel.
1—Tolhurst 26" Suspended, steel.
1—Tolhurst 26" Suspended, 316 S/S.
1—Tolhurst 26" Suspended, rubber.
2—Sharples PN Super-D-Canters, S/S.
2—Bird 18"x28" Continuous 310 S/S.
2—Sharples C-27, C-20 S/S Super-D-Hydrators.
2—Sharples #16P Monel and S/S. Super Centrifuges.

SPECIALS

1—NEW 3000 gal. 304 S/S Reactor.
1—DeLaval AC-V "Nozzle-Matic" 304 S/S Continuous Centrifuge.
1—2800 gal. S/S Horizontal Storage Tank 5'x18'.
1—4000 gal. S/S Vertical Vessel 6'x16', built for pressure weight 15,000 lbs.
26—Atmospheric Heat Exchangers S/S, 437 and 715 sq. ft.
2—#12 Sweetland Filters, 680 and 810 sq. ft., with S/S leaves and fittings.
1—Oliver 8'x10' Monel Rotary Vacuum Filter.
1—Buflovak 800 gal, 347 S/S jacketed, agitated Reactor.
1—7' dia. x 25'6" Bubble Cap Tower, 347 S/S.

PULVERIZERS—CRUSHERS

1—Devine 5'x10' steel, jacketed Mill.
1—Raymond 3 Roll High Side Mill.
4—Hardinge Mills 4½x16", 5'x22" 5'x36", 6'x22", 10'x48".
4—Patterson 6'x8', 5'x6', 3'x4' brick-lined Pebble Mills.
1—Patterson 6'x8' porcelain (Berylite) Pebble Mill, 50 HP. NEW.
3—National 10"x20", 6"x12" Mills.
3—Gayco Air Separators 12', 8', 18".
6—Mikro Pulverizers #4TH, #3TH, #2TH, #2DH.

MIXERS

8—Day "Cincinnatus" double arm Sigma Blade, 660, 250 and 100 gals.
2—Baker Perkins 100, 50 gal. Sigma Blades, jacketed.
5—Sprout Waldron S/S. jacketed Powder Mixers, 67, 27 and 10 cu. ft.
1—Struther Wells 6'x9' S/S. jacketed.
2—Baker Perkins 2 gal. S/S.
1—Robinson 4000# steel powder.
6—Rodgers 400 to 3000# powder.
3—Simpson Intensive Mixers #0.
8—NEW Portable Agitators ¼ to 5 HP.
4—Day, Ross 8 and 50 gallon. Pony.

TOWERS—REACTORS—CONDENSERS & TANKS

1—Buflovak 800 gal. 347 SS Clad, jacketed, agitated Reactor.
1—Buflovak double effect, Vertical S/S Evaporator, 900 sq. ft.
7—Towers 8'x58' Chrome Lined, 6'x65', 6'x27', 5'x27', 42"x49', 3'x53', 30"x38'.
4—Foster-Wheeler Karbate Heat Exchangers 188 sq. ft.
3—2400 sq. ft. Admiralty Heat Exchangers.
12—Heat Exchangers 50 to 1350 sq. ft. S.S. & Admiralty.
5—Buflovak Condensers 20 to 90 sq. ft.
1—1400 gal. Aluminum Tank.
1—NEW 3000 gal. 304 S/S Reactor.

MISCELLANEOUS

10—Nash Vacuum Pumps TS12, TS8, H7, H6, L5, L3 MD571, #4, #2.
5—Stokes Vacuum Pumps 10 to 50 cfm.
14—Olivite, Duriron S/S Centrifugal Pumps 1" to 6".
10—Centrifugal Pumps 60 gpm to 2000 gpm, motor driven.
2—Stokes DD2, D3 Tablet Machines.
1—Kux Rotary Tablet Press 15-25.
2—Cumberland #0 Rotary Cutters.

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Gemco 56 cu. ft. Double Cone Blender.
J. H. Day 50 gal. Imperial S.S. Jacketed Double Arm Mixer.
Day, Robinson, Bailey, 15 to 10,000 lbs., Dry Powder Mixers.

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Davenport Rotary Steam Tube Dryer, 6'x36'.
2—Stainless Steel Steam Jacketed Readco Mixers.
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Merco B9, SS, 15 HP.
Tolhurst, 20", SS, perf. basket.
Fletcher, 40", SS, perf. basket.
Sharples C20, SS, Super-D-Hydrator.
Sharples D2, SS discs. NEW.
Sharples C27, SS, Super-D-Hydrator.
Sharples PN14, SS, Super-D-Canter.

COLUMNS

SS 18-8 Scrubber, 12"x15'.
SS 347 lined, Scrubber, 5'x18'.
SS 347, 6'x29', 21 trays.
Steel, 4'x53', 23 trays, 160 PSI.
Steel, 2'x47', 20 trays, 375 PSI.
Steel, 3'x49', 28 trays, 425 PSI.
Everdur, 5'x23', 24 trays.
Karbate #22, packed, 19"x12', NEW.

DRYERS

Rotary Vac. 5'x15' nickel clad.
Rotary Vac. 30"x8', Stokes 59AB.
Rotary 26"x8' oil fired with feeder.
Rotary 4'x27' oil fired, motor drive.
Rotary 5'x67' 6" lifters.
Rotary SS, 4'x30', complete.
Rotary Kiln 8'x125'x¾" firing hood.
Rotary Kiln 10'x200'x¾" oil & gas burners, comb. chamber, dust collecting system.
Roto-Louvre 604-24 complete w/furnace.
Roto-Louvre 705-20 SS heating coils comp.
Roto-Louvre 310-12, heating coils comp.
Roto-Louvre 502-20 comp. w/furnace.
SS Spray, 10'x36', gas fired.
Single drum, 5'x6' Atm. scraper.

FILTERS

8'x12' Feinc, steel, string discharge.
8'x10' Oliver, steel, drum.
Sweetland #5, SS lined, hyd. closure.
5'x3' Feinc, string discharge, steel & rubber. NEW.
3'x4' Oliver, steel, complete.

HEAT EXCHANGERS

100 sq. ft. SS 40# shell 60# tubes.
180 sq. ft. steel shell copper tubes.
198 sq. ft. steel 325# Adm. tubes 125#.
252 sq. ft. steel 400# shell 150# tubes.
415 sq. ft. steel shell 125# Adm. tubes 50#.
550 sq. ft. steel 325# shell 160# tubes.
1035 sq. ft. steel 250# shell & tubes.
1800 sq. ft. steel shell Everdur tubes.
3300 sq. ft. steel 150# shell & tubes.

MIXERS

100 gal. Readco Jktd. dbl. sigma blades power & tilt.
170 gal. Ajax dbl. arm, power pump.
1050 gal. Paddle dbl. shaft heavy duty NEW.
3900 gal. hor. jktd. 75 PSI paddle agitator.
29 cu. ft. Patterson Conical Blender.
67-27-10 cu. ft. SS Sprout Waldron Powder.
550 cu. ft. SS jktd. rotating oscillating.

PULVERIZERS

Raymond #1 Automatic.
10'x48" Hardinge Ball Mill.
Raymond #40 Imp, Stainless.
CHURN—Baker Perkins, 700 Gal. Cap.
EXTRUDER—Stainless Steel Screw 2½".
HYDRATOR—Lime, Clyde #3.
KOMBINATOR—Flowmaster K200.
MICROSCOPE—Electronic RCA, complete.

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12—7½ HP Reeves Moto Drives—Horizontal Type
11—550V—3 Phase—60 Cycle
1—220V—3 Phase—60 Cycle
43—1½ HP U.S. Gearhead Motors — 100 RPM Type GD
29—550V—3 Phase—60 Cycle
14—220V—3 Phase—60 Cycle

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When The Boss Demands More Production But F-A-S-T the right answer is

READY-REBUILT-EQUIPMENT!

MILLS—GRINDERS—CRUSHERS

4041 P39—Abbe Porcelain Lined Pebble Mill; 32"x32"
3745C—Two Patterson Buhrstone Line Pebble Mills; 6'x5' and 6'x3' complete with pebbles
3693—Steel Ball Mill, 34"x38"
3443—International 8'x8' Porc. Lnd. Pebble Mills; 50 HP Gearmotors
3789—Patterson Pebble Mills from 20"x30" to 6'x8'
3564—Abbe 50 gal. Porc. Lined Pebble Mill; 20"x30"
3800—Hardinge Conical Ball Mill with Titanite Liners; 10'x48" with scoop feed and accessories
4147 C9-10—Two Smidth Tube Mills 5'5"x20'; V belt drive
4147—C3-6—Four Gates Tube Mills; 5'x22'
3655 W2—Gruendler Supermaster No. 1 Hammer Mill; 15 HP
4082 A1—Mikro Pulverizer Model 2 S1 Bronze Chamber; PD
M10 D200—Mikro No. 2 SP Pulverizer; 10 HP with 2 HP Pre Crusher
3331—Mikro No. 2 TH screw feed with Pre-Breaker
3324 E2—Mikro No. 4 F Pulverizer; 15"x24"
3868N-1—Fitzpatrick Model D Stainless Comminutor; cooling jacket
3705 L3—Fitzpatrick Homoloid Pulverizer; motorized
1001 N1—Williams Model NF Hammer Mill; 25"x 14"; requires 60 HP
3429 A7—Williams Hammer Mill 36"x13"; requires 60 HP
3429 A-5-6—Williams Hammer Mill No. 4 18"x 48" requires 60 HP
4147 C14—Williams No. 6 Hammer Mill
3769—Jay Bee Model 2U Hammer Mill; 10¾"x14" requires 20 HP
3429 A8—Gruendler Pulverizer 12"x48" requires 150 HP motor
3192 A1—Gruendler Pulverizer No. 3 chamber 8"x16"
3429 A9—Gump Bar Nun No. 40 Hammer Mill; 12"x40"; requires 60 HP
3545—Jay Bee Model A4 chamber 12"x18" with 25 HP motor
3277—Robinson 26" Double Runner Attrition Mill; two 10 H.P. motors
3529W—Bauer 24" Double Runner Attrition Mill with two 20 HP motors
3120—American Ring Roll Crusher; 30"x33" throat; 50 HP
4041 P49—Sturtevant Rotary Fine Crusher, Model "00"; 3,000 tons per hr.
4147 C13—McCully No. 10 Crusher; Belt & P.D.
3315 E2—Williams Ring Roll Mill; ring 3"x10"; with 3 rollers 4" dia. arranged for motor drive
3293 N1—Raymond Imp Mill 9"x18" with accessories
2383—Raymond Model No. 00 Aut. Pulverizer with accessories
3853-S—Raymond No. 50 Stainless Imp Mill with 50 HP motor
4066G—Raymond No. 47 Imp. Mills; 50 HP motor
4062 K2-5—Four Raymond No. 32 Imp. Mills; 20 HP motors
MWK-1—Sprout Waldron Roller Mill 2 pair high; 9"x18"; 10 H.P.
4041 P43-44—Two Robinson Unique 4 Roll Mills; 7"x24"; 20 HP
4042 K3—Sprout Waldron 2 Pair High Roller Mill; 9'x18"; 10 HP
3625 D2—Munson Rotary Cutter Size "0" 3½"x11" feed opening

CENTRIFUGALS

4041/P40—A. T. & M. 12" Stainless Suspended Type Centrifuge
3615—G1—Tolhurst 48" Overdriven; perforated Basket; Rubber cov. 10 HP.
1152 Mc—Bird 48" Rubber Cov. Extractor; with 40 HP 2 speed motor
1152 Mc1—Bird 12" Rubber Lined Centrifuge with extra imperforate Basket
C4-500—Tolhurst 20" Stainless Extractor; Perforated Basket; under driven
2945 M4—Tolhurst 40" Overdriven; self balancing with Copper Basket, perforated; 7½ HP motor
4042/K1—A. T. & M. Stainless Suspended Centrifuge; 30"x15"; 20 HP

EVAPORATORS—VACUUM PANS

SPECIAL:—Zaremba Double Effect INCONEL Evaporator with calandria; 430 sq. ft. of surface; with accessories; print available
3274—Swenson Quadruple Effect Long Tube Evaporator; film type
3475—Zaremba Single Cast Iron Evaporator; 130 sq. ft. Copper tubes
2895—Devine Single Cast Iron Calandria type; 28"x8'
3515—Acme 1600 Gal. Copper 6'x10', coils barometric condenser, etc.
3557—Croll Reynolds Vac. Evaporator; 30"x5' MONEL with accessories
3670 Copper Vac. Evaporator; 66"x73" coils, heat exchanger
487—Zahn & Nagel Continuous Evaporator; 2500 lbs. per hour
3497 S7—Jacketed Crystallizing Evaporators; 24"x 21"x12' long
3340—Brand NEW Stainless Steel Kettles good for 100# always in New York stock; sizes up to 500 gal. immediately
3926—Stainless Clad 80 gal. steam jacketed Kettles; 40#
4041 P35—Four Glass Lined 100 Gal. 31"x36" Jktd. Kettles
4041 P46-47—Two Stainless Jacketed & Agitated Pasteurizing Kettles; 46"x30"
3444—Pfaudler Glass Lined Jktd. 350 Gal. Kettle 54"x36"; agitated
3730 FRF—Pfaudler 1000 Gal. Glass Lined Reactor Type XL 66"x66" with 5 HP motor
3247—Aluminum Steam Jacketed Kettles from 25 gal. to 250 gal.
9908 H3—Aluminum Vacuum Pan 250 Gal. 40"x 60"; Jacketed

REACTORS

3424 K4—Stainless Reactor; with coils agitated; 24"x48"
3824S-12—Pfaudler Glass Lined Jacketed Agitated Reactor; 12"x12"
3824S-14—Pfaudler Glass Lined Jacketed Reactor; 36"x36"
3673 L9—Pfaudler Glass Lined Jktd. Reactor; 16"x 28"
3944 B2—Steel Jacketed and Agitated Reactor; 315 Gal.; 44"x48"
3168—Stainless 500 Gal. Jacketed Reactor; 6' dia. x 30" straight side
3168 D7—Dopploy Jacketed Reactor
3390—Buffalo 500 Gal. New Jktd. Agtd. Reactor; 4'x5'2" motorized
3434—Dopp 650 Gal. Cast Iron Full Jktd. Agitated Reactor; 80"x67"
3994 K5—Monel Reactor 785 gal. 5'x5'; Jktd.; Agtd.
3934 C41—Steel Reactor; 950 Gal. 5'x5'6"; agitated; coil heated
4113 D1-2—Two Struthers Wells Stainless Vacuum Pans, 5'x12'8" high with Calandria section 350 SS 2" tubes; 630 sq. ft. 200 PSI
3113 E2—Copper Vacuum Pan; coil heated; 2000 Gal. 7' diameter
3799V-1—Lancaster Stainless Lined Rotary Reactor; Jktd.; 50"x17'4" 300 PSI internal
3870M-2—Mojonnier Stainless Vacuum Pan, 3'x10'
3434—Dopp 650 Gal. Cast Iron Jacketed and Agitated Reactor
3934 C8—Bethlehem Reactor 1400 Gal. Steam Coils Cast in shell
R4 505—Devine 1500 Gal. Vertical Nitrating Kettle; 6'x8'6"; Jktd.
R4 507—Dowtherm Jktd. Stainless Agtd. Kettle; 2500 Gal. with accessories
3598—2600 Gal. Steel Jktd. Agitated Pressure Vessel

COLUMNS AND STILLS

3984R—Stainless Steel Columns; 8"x10' and 12" x15'
C13-200—Stainless Steel Generating Column; 48"x 31' high flanged and bolted sections
3476—Copper Jacketed Still Pot; 28"x25" with condenser
3659 R3—Aluminum Bubble Cap Column; 27½"x 36"; 60 plate
C13-140—Stokes Copper Bubble Cap Column; 36"x 18'
C14-220—Stainless Packed Column; Raschig rings; 4"x10' with Still Pot
C-13-162—Steel Bubble Cap Column; 48"x37' high with accessories
C14-151—Solvent Recovery Absorber; 8'x28' with accessories
9908 H3—Aluminum Steam Jacketed Vacuum Still; 40"x60"
3470—Stainless Steel Bubble Cap Column; 16 sections; 8⅝"x19' high

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PHONE: STerling 8-4672

BLUE CHIP EQUIPMENT*

This is Partial list of 5000 Items

1—Sharples Super-D-Hydrator C20, 20 HP XP motor, SS Constr.
2—Stokes T-4 & S-5 Tablet Presses
4—Patterson 4', 5' and 6' conical blenders, MD
2—Fitz Comminuters style D 7½ HP XP motors
21—Aluminum Condensers or Heat Exchangers 400 & 800 sq. ft.
1—Sparkler 18" S/S Filter
1—Bowen S/S spray dryer 10' dia. x 28'
4—Patterson 4' x 4' chrome manganese jktd. ball mills, 225 gals.
1—Morehouse speed line mill, 20 HP.
1—36" Iron P & F Filter Press 30 chamber, closed del.
1—Baker-Perkins 500 gal. Model R E M Jacketed double arm mixer
2—7500# dry powder mixers, double ribbon type.
1—New Bird-Young 4' x 2' S/S Vac. Filter
12—Wooden Agit. Tanks 8000-30,000 gals.
1—Unused 18,000 gal. ASME code, 200 lb. Press. Tank
4—B & J & Cumberland Rotary cutters 2-60 H. P.
1—J. H. Day 40 gal. Pony Mixer
2—Ross 30 AB heavy duty post mixers, 135 gals.
6—Sperry 18" open del. filter presses 23 & 44 chambers
1—Hersey Dryer-Monel Metal 3' x 24'
3—Beaird Dryers 4' x 30'
1—Louisville SS 316-6' x 45' tubular dryer, aluminum tubes.
1—Pittsburgh Lectro Dryer size 25 BAC
7—Day 10, 20, 50, 75 & 100 gal. Dble Arm Mixers
1—210 Worthington Refrig. Unit, Turbine Driven
7—Karbate heat exchangers, 20.6 sq. ft. & 70.6.
1—Kilby 695 sq. ft. S/S Sulphur Filter
2—Patterson 3' x 4', 100 gal. Porcelain pebble mill
1—Simpson #2 mixer, M.D.
2—1-40" link suspended SS centrifuge, 7½ HP motor.
5—48" x 120", 24" x 36", 32" x 52" DBLE drum dryers, one vacuum.
1—New Shriver 32" x 32" side fee, open delivery 2" frame.
1—Devine SS 10 shelf vacuum shelf dryer, 23½" x 29".
4—12'6" Jeffrey bucket elevators.
1—12" Shriver rubber press, 13 chamber.
1—American Tool 40" bronze, bottom discharge, suspended centrifuge, MD
1—Buflovak monel single effect evaporator, 148 sq. ft.
1—Colton #5½ T single punch tablet machine
2—Sweetland #12 & 10 filter, 1 S/S
3—Pfaudler 500 gallon model ELL glass lined reactors, agitated
1—Feinc 5'3" x 3' monel vacuum filter.
3—Triple, DBLE & single effect Evap. one monel
1—Buflovak 40" x 48" single drum flaker.
2—Sperry, 48" x 48" 50 chamber wood filter presses, HYD closing.

*Subject to Prior Sale

CURRENT LIQUIDATIONS

A. Chemical Vitamin A Plant . . . Ga
B. Pigment Plant . . . Delaware
C. Ore Smelting Plant . . . N. J.
D. Caustic Chlorine Plant . . . Kentucky

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—Prompt Shipment—

GLASS LINED TANKS — USED — 3000 gallon capacity. Welded construction — Fully insulated. Equipped with manhead. Suitable for milk, food products, lily white chemicals, solvents and fine lacquers.

VARNISH TANKS—USED—54" diameter x 14'6" high (or long) ¼" Steel—Welded construction—1700 gallons.

MISCELLANEOUS TANKS—Various sizes and types.

ERMAN-HOWELL DIVISION
LURIA STEEL & TRADING CORP.

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EQUIPMENT FOR SALE

1 Guardite Moistening and Ethylene Oxide Sterilizing Unit 6'6" x 7-0' x 16-0' Unit is complete and in excellent condition.

1 Stainless Steel Blender - Struthers-Wells 6'6". New condition—bargain price.

1 complete Organic Acid Esterifying and Purifying Unit—pumps, glass lined — S.S. and copper tanks. Pyrex fractionating column and condensers.

1 Pneumatic Scale Company 16 head vacuum filler. S.S. heads and Reservoir Tank.

3 Labelers — Standard-Knapp Wrap Around.

American Maize-Products Company
HAMMOND, INDIANA
Attention: James Mc Cabe
Phone South Chicago 8-9270

All items listed subject to prior sale or use by Eli Lilly and Company.

8 Podbielniak, Type 316 S.S. centrifugal, multistage, counter-current liquid-liquid solvent extractors. 1 Serial #6060, 8 Serial #6070, Engineering data available. Original cost 1947—$12,500 ea. Used. PRICE $2,500 ea.

1 Buffalo Vac 12" x 18" Drum Drier S.S. Blade and Drum. Used PRICE $1,500

3 Devine single door vacuum shelf driers. 6 shelves, 9" apart. 80 square feet effective pan surface. Drawing available. Replacement cost $5,500 ea. New. PRICE $2,500 ea.

1 Polar Still, 3 Rotameters, 1 Tapered Tantalum condenser, 1 Copper condensor 24 square feet, 1 Tilting Kettle on casters 200 gallon.

All Items F.O.B. Indianapolis

ELI LILLY AND COMPANY
Plant Salvage Department John H. Compton
740 S. Alabama Street, Indianapolis 6, Indiana
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For Sale **For Sale**

1—Eppenbach Stainless Steel Home Mixer complete with ½ HP Explosion-Proof Motor.
2—Premier 6" Colloid Mills, Motor Driven.
1—10" Premier Colloid Mill.
2—Motor Driven Belt Conveyors.
5—Pony Mixers, 8, 15 and 40 gal.
High Speed Roller Mills 9"x24" to 16"x40".
1—J. H. Day 40-Gallon Pony Mixer.
1—Eppenbach Colloid Mill, Model QV-8-1.

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EQUIPONOMICS

BIRD CONT. CENTRIFUGE—36" x 50", S.S. 304
CENTRIFUGE—ATM Suspended, Steel, 48" complete with 40 H.P. TEFC motor, 2 sp.
CONDENSERS, 8—all monel, 75 to 100 sq. ft. Shell and tube.
DRYER, Buffalo, double drum, 32" dia. x 90". Reconditioned. Complete with vari drive & motor.
FILTER, Sperry—24", P & F, all bronze, 28-1" frames. NEW.
KETTLES, G/L Pfaudler, 200, 300, 500, and 1000 gal. complete.
NICKEL CLAD KETTLE, Jktd. Agit. 750 Gal. ASME.
FLTER—Oliver 3' x 4' S.S.
HEAT EXCHANGERS—500 sq. ft., Carpenter 20 S.S., 240—1" x 8' tubes.
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Phone: Elizabeth 4-2722

FOR SALE

Column, 64" dia. 13 plates chrome iron.
Cube Blender, 76" x 76" S.S. T304 #4 finish.
Hammer Grinder, Stedman BX 20 by 12.
Mixer, B-P #14 JEM, Jkt. Vacuum Double Naben.
Mixer, Day Size F, 400 gal. Double Ribbon.
Filter, Niagara 95-36 Pressure Leaf.
Filter, Seitz V40-10 Flexmaster S.S. T316.
Filter Press, 2—Sperry 30"—40 frames and plates.
Centrifuge, Tolhurst Suspended 12" S.S. T316.
Spray Dryer, 18'-0" dia. Stainless T304.
Dispersion Dryer, Western Precip. 60" Cyclone and Multiclone S.S. T304.
Vacuum Pans, various, 36" to 72" all S.S. T304.
Exchanger, 785 sq. ft. S.S. T316, 200 tubes.
Tanks, 2—14,000 gal. Glass Lined.
Tanks, 2—2500 gal. S.S. T304 Sanitary.

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YOU'LL QUICKLY FIND HIGH QUALITY USED EQUIPMENT IS YOUR BEST BUY—

When You Buy GELB

2—Buflovak Double Drum Chrome plated Dryers, 24" x 36", complete.

1—AT&M Suspended Type Centrifuge with 18" Type 316 Stainless Steel basket, complete with plow and motor.

7—Ames 100 HP at 125 PSI Package Boilers.

1—Day "Cincinnatus" 200 gal. sigma blade Mixer.

THE GELB GIRL—AUGUST, 1955

AUTOCLAVES—KETTLES TANKS

4—Pfaudler 50 gallon glass lined vacuum receivers (New).
1—Nooter steel jacketed vacuum kettle, 750 gallons.
1—Patterson-Kelly Steel Jacketed Kettle, 1500 gallons, ASME.
1—Plate Fabricators 6,000 gallon Jacketed Kettle.
1—Pfaudler 150 gallon Stainless Steel Jacketed Kettle with Anchor type agitator.
12—Koven Stainless Steel Jacketed Vacuum Kettles, 380 Gals. Cap. Each.
1—Stainless Steel, 4000 gal. Tank.

CENTRIFUGALS

1—Bird Stainless Steel 48" suspended type Centrifuge with perforated basket, plow and explosion proof motor.
2—Sharples S.S. super pressurite contrifuges. Model 16.
2—Sharples Type 316 Stainless Steel Centrifuge, Model D2.
1—DeLaval Type 316 Stainless Steel Multi-Matic Centrifuge.
1—Ellis, Stainless Steel, 30" centrifuge.
1—Fletcher S.S. Suspended Type Centrifuge, 40" Perforated Basket.
1—A. T. & M. Stainless Steel Susp. Centrifuges, 48" Imperforated Basket.

DRYERS—KILNS

1—Devine Double Drum Vacuum Shelf Dryer, 13 shelves.
5—Buflovak Single Door Vacuum Shelf Dryers 5, 7, 10 and 20 shelves.
1—Proctor & Schwartz Hot Air Dryer, 16 shelves.
1—Devine laboratory vacuum shelf dryer with 3 S.S. shelves (New).
1—3' x 12' Stainless Steel Rotary Vacuum dryer.
1—Steel and Alloy 3' x 15' Heresite-lined Rotary Vacuum Dryer.
1—Stokes Rotary Vacuum Dryer, 30" x 8'.
1—Buflovak 32' x 90" Double Drum Dryer—Complete.

CONDENSERS, HEAT EXCHANGERS & COLUMNS

5—Stainless Steel Condensers, 15, 20, 30, 55 and 90 sq. ft.
1—Oliver Rubber-lined Pressure Filter, 3'x6'.
2—Sparkler Filters, Model 18-S-4 and 18-S-8.
1—Sperry 36" Plate and Frame Open delivery Filter Press, 40 ch.
12—Struthers Wells S.S. heat exchangers, 650 sq. ft. each.
1—Hatfield Stainless Steel Bubble Cap Column, 6' x 16'6", 7 trays.
4—Alco Steel Heat Exchangers, 360 sq. ft. each.

FILTERS

1—Shriver, 36", 3 eye open delivery, washing type Filter Press with 35 chambers and Simplex hydraulic closing device.
1—Filtration Engineers Type 316 Stainless Steel Rotary Vacuum Filter, string discharge, Size 6' 6" x 6' (New)
1—Filtration Engineers, Type 304 Stainless Steel Rotary Vacuum Filter, string discharge, Size 3' x 3' (New)
1—Vulcan Bubble Cap Column, 66" dia., 45 plates.
1—Shriver C.I. Plate and Frame, 2 eye, open delivery Filter Press 42" x 42", 54 chambers.
1—Sperry 3-eye, closed delivery, cast iron. Plate and frame Filter Press, 9 ch., 30" x 30".
1—Sperry Wooden Plate and Frame Filter Press, 12" x 12", 15 chambers.

MIXERS

1—Banbury Mixer, midget size with 2 HP motor.
4—Lightnin' Side Entering Mixers, 20 HP, explosion-proof 425 RPM.
1—Day Stainless Steel Double Arm Jacketed Sigma Blade Mixer, 50 gal.
1—Struthers Wells Northmaster vacuum mixer, dispersion blades.
6—Simpson Intensive Mixers #0 and #1.
1—Read 10 gallon Stainless Steel Double Arm Sigma Blade Jacketed Mixer, with vacuum cover.

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2—BUFLOVAK 6'x5'6" single drum monel Flakers. NEW.

2—I.R. Jet Refrigeration Units 208 and 136 tons.

1—ILLCO Duplex Ion Exchanger, two 5x9 316 S/S Tanks with 182 cu. ft. of Dualite A-7 Resin.

1—RIETZ 30' "Thermoscrew" Conveyor Dryer 304 S/S.

1—LINK BELT Twin Screw Conveyors 316 SS, 18"x10'.

3—SCHALLER 4'x13' 316 SS Reactors with tubular calandrias 513 sq. ft. each.

1—PFAUDLER 250 gal. Hastelloy "C" Reactor.

2—PFAUDLER 2300, 1200 gal. glass lined Tanks

1—PATTERSON 7'6" Conical Blender, rubber lined.

2—PFAUDLER Monel Heat Exchangers 62 sq. ft. each.

9—KARBATE Heat Exchangers 370, 255, 188, 170, 160, 70 and 16.4 sq. ft.

2—KARBATE Centrifugal Pumps, Series 3A, 5 HP XP motors.

3—LAWRENCE 316 S/S Vert. Centr. Pumps 70 to 350 gpm, XP motors.

4—LINK BELT 12" rubber belt Conveyors 30' to 77' cc.

Pipe, Valves & Fittings

3000 ft. 2" to 6" Saran lined pipe, fittings and 250 valves.

500 ft. 1" to 4" S/S 316, Nickel, pipe, fittings, valves.

2000 ft. 1" to 4" Glass Lined Pyrex, Karbate pipe and fittings.

100 Lapp Porcelain valves and fittings 1" to 4".

50 Instruments, Fisher Porter Flowmeters with Hastelloy and Tantalum fittings, Foxboro Temp. Recor.

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Devine #12 Vac. Shelf Dryer 40" x 42" Shelves.
1—Stokes 2' x 6' Rotary Vac. Dryer.
Gen. Amer 2' x 1' Continuous Rotary Vac. Filter.
2—Albright-Nell 4' x 9' Atmos. Drum Dryers.
1—Buffalo Vac. Drum Dryer 24" x 20".

CENTRIFUGALS & CENTRIFUGES
4—Tolhurst 40" Suspended Type Centrifugals.
8—Centrifugals 12", 30", 40" & 48" Steel, Copper, Stainless & Rubber Lined.
6—Sharples Centrifuges #5A Stainless. Also #6.
3—De Laval Multiple Clarifiers #200, 300 & 301.

FILTERS
#2 Sweetland Filter 12 Stainless Covered leaves.
1—Vallez 41 Stainless Covered Leaf Filter, type 49.
Sperry & Shriver 12" to 36 sq. iron & wood.
Sweetland & Oliver Rotary Vac. Filter.

KETTLES & TANKS
Pfaudler 500 gal. Glass Lined Reactor Kettle.
1—Dopp 350 gal. C.I. Jack, Vac. Kettle.
Devine & Stokes Impreg. Units 30" & 36" dia.
Devine 1000 gal. closed Jack. Steel Kettle.
1—2300 gal. vert. agit. jack. Steel Kettle.
8—Jacketed Kettles 50 to 2300 gals.
1—250 gal. Lead-Lined Kettle.
2—500 gal. vert. Glass Lined Tanks.
50—Stainless Alum., Copper, Glass & Lead Lined Kettles & Tanks. Also new Stainless.

PULVERIZERS & MILLS
2—Mikro Pulverizers #2TH #4TH.
Patterson 30" x 42", 4' x 5' & 6' x 4' Pebble Mills.
Abbe 30" x 30" & 30" x 36" Pebble Mills.
Abbe 37" x 30" Chrome-Mang. Ball Mill.
#1 Raymond Automatic Pulverizer 20 H.P. motor.
1—Raymond #00 Pulverizer 30 H.P. Complete.
2—#0000 Raymond Mills.
Sturtevant #0, 18" Hinged Hammer Mill.
Jeffrey 18" x 18" Single Roll Crusher.
Buchanan 5" x 12" Jaw Crusher.
Hammer Mills & Pulverizers 3 to 50 H.P.
1—Schutz-O'Neil 20' Pulverizers. Also #1.
Williams #3 & 2xx Hammer Mills.
1—Robinson 18" x 22" Attrition Mills.
1—Lehman 4 Roll W.C. 12 x 36" Steel Mill.
3—Steel 3 Roll Mills 9"x32", 12"x30" & 16"x40".
1—9" x 24" 3 pr. high steel Roller Mills.
3—Hauchin 18"x36"; 4 Roll Granite Stone Mills.
Ball & Jewell Rotary Cutters Lab. #1 & #2.
2—U. S. & Premier 1½ H.P. Colloid Mills.

MIXERS & SCREENS
H.K.-Porter 42" dia. Stainless Conical Blender.
Lancaster 6' dia. Vert. Mixer 25 H.P.
Baker Perkins double arm 100, 50 #9 gals.
2—Read 50 & 100 gal. double arm mixers.
Kent 3 HP. Continuous Dry Mixer.
Horiz. Mixers single & double arm to 200 gal.
3—Day 8, 15 & 40 gal. Pony Mixers.
Read 40 and 80 qt. vertical Mixers.
6—Lead & Paste Mixers 50 to 150 gals.
Tyler 5' x 8' Vibratory 2 Deck Screen. Other sizes.
Blystone 3000# horiz. spiral mixer.
10—Dry Spiral Mixers 50 to 3000#.
12—Portable Elec. Agitators ¼ to 3 H.P.

MISC. & SPECIAL
Kux 2½" single punch Preform Machine.
Anderson & French Oil Expellers.
Gould 75 HP Centrifugal Pump, 250 PSI.
1—Marco 200 Stainless Steel Homogenizer.
Filling Machines powder, paste & liquid.
Rotary & Single Punch Tablet Machines, ½" to 4".
1—Howe Mogul Barrel & Bag Packer.
2—Worthington 12" x 12" x 12" Vac. Pumps.
6—Devine Stokes & Buffalo Vac. Pumps.
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BUFLOVAK DOUBLE DRUM DRYER 32" x 52"
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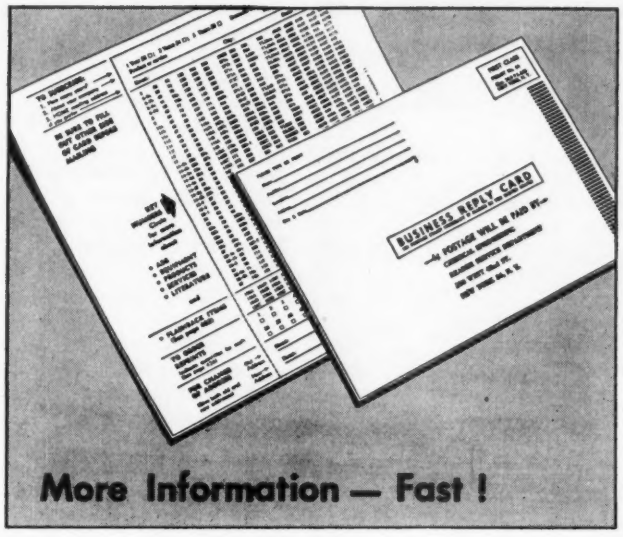

INDEX TO CHEMICALS & EQUIPMENT

Chemicals and materials **388**
Equipment and accessories **389**
Processes and services **396**
Flashback: Last month's new products **397**

GUIDE TO TECHNICAL LITERATURE

Chemicals and materials **398**
Construction materials **402**
Electrical equipment **404**
Handling and packaging **406**
Heating and cooling **407**
Instruments and controls **410**
Mechanical equipment **404**
Pipe, fittings, valves **412**
Process equipment **415**
Pumps, blowers, compressors **418**
Services and processes **422**

INDEX TO ADVERTISERS

Alphabetical list of firms in this issue **424**

CHECK LIST OF REPRINTS

Editorial reports and other reprints now available **430**

READER SERVICE POSTCARDS

Get more information—fast ..... **Inside Cover**

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Now it's easy. Just use CE's new directory of products, equipment and services. It's a complete, finger-tip reference to each month's advertised items and new product developments. (p. 388)

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Index to Chemicals & Equipment

What It Contains . . .

Here's your complete index to the chemicals, materials, equipment and services advertised in this issue, announced in the Chemicals & Raw Materials and Process Equipment News departments, or listed in this issue's Guide to Technical Literature.

What the Code Means . . .

Each item has a code that's the key to its location in this issue. The numerals show the page where you'll find the item mentioned. The letters L (left), R (right), T (top), B (bottom) locate ad positions on the page; the letters a, b, c and A, B, C identify items on a page or in an ad.

For More Information . . .

You can get more information on any product listed in this directory by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, then mail to us. Answers will come to you direct from the companies manufacturing the products.

Contents of This Section . .

Products in this Index are categorized as follows:

	Page
Chemicals & materials	388
Equipment & accessories	389
Processes & services	396
Checklists of last month's new products	397

Find it tough to keep up with chemical products and equipment? You can use this master index as a quick way to spot exactly what's in each issue on any particular item.

Chemicals

Absorbers, ultraviolet light....148F
Acid
- Adipic 398A
- Barbituric 398B
- Benzoic 152a
- Citric, bulletin 15.....363a
- Itaconic 398C
- Naphthenic 398D
- Oxalic, bulletin 34.....363b
- Peracetic 398E
- Phosphomolybic 398F
- Propionic 398G
- Stilbenedicarboxylic 398H

Acids, fatty 398I
Acrylonitrile 398J
Alcohols, fatty 140A
Algicides 272c, 398K
Alumina trihydrate.....398L
Amines
- Aliphatic 398M
- Dimethyl tertiary 398N

Ammonium persulfate 398O
Amyl acetates, primary.....398P
Anesthetic, steroid 148E
1,4-Butanediol 398Q
Butyl oleate 398R
Calcium carbonates.....398S
Carbon, activated...93, 398T, 399A
Carbon black.....399B
Carbonate of potash 57c
Catalysts 38
- Bulletin G260 304
- Kaolin 144A

Chelates 399C
Chemicals TL323, 399D, 399E
- Chromium 399F
- Fine 399G
- Laboratory 399H
- Metal finishing, bulletin 61...363c
- Organic 263
- Reagent 399I
- Sodium silicate 399J

Chlorine, liquid 57a
Chromic acid, corrosion-proof..148B
Coatings, dispersion 147
Cryolite & aluminum fluoride..399K
Defoamers, silicone R409
Detergents 400A, 400B, 400C
Dialkyl amino alkyl chlorides...400D
Dicumyl peroxide.....144C
Diethanolamines, fatty 142A
2,6-Diethylaniline 400E
Di-iso-octyl phthalate.....400F
Diluents 400G
Dispersing agents 400H
Dispersions 400I
Emulsifiers 400J
Emulsifying & anti-foaming agents 400K
Epichlorohydrin, booklet SC: 49-35 111
Ethylene polymer 400L
Fertilizer 148G
Formaldehyde 400M
Furfural, bulletin 203-A.....298
Gelling agents 400N
Glycerine 399, 400O
Herbicide, aminotriazole.....146C
Hydrocarbon, hard 400P
Hydrogen peroxide vapor.....400Q
Insecticides, toxaphene.....272a
Isophorone 400R
Ketones, aliphatic 400S
Latices
- Concentrated 400T
- Resin & plastic 400U

Lithium borohydride 400V
Lithium chloride 400W
Lubricants 144B
- Valve, low temperature.....146A

Methionine energy concept....400X
Methyl isobutyl ketone.....400Y
Molybdenum 400Z
Nitrate of soda 400AA
Oils 364
- White 400BB

Oxides, iron 301
Paper, glass 148C
Papermaking chemicals.....272b
Paradichlorobenzene 57d
Pentachlorophenol 400CC
Peroxide bleaching processes..400DD
Phosphating compounds.....400EE
Piperazines & pyrazines.....400FF
Plasticizers 400GG
Polyethylene, flame-sprayed 148A
Polyvinyl acetate emulsions ..400HH
Potash, caustic 57B
Propylene polymers 400II
2-Pyrrolidone 400JJ
Refractory grains 91
Resins 12, 15, 400KK
- Casting 401A
- Ion exchange 326
- Laminating 401B

Rosin 148D
Silica, colloidal 401C
Soaps-detergents 401D
Soda, caustic 57e
Sodium Benzoate 152b
Sodium hydrosulphite 66
Sodium metasilicate BL411a
Sodium orthosilicate BL411b
Sodium sulfate 159
Solubilizers 401E
Solvents 401F
- Petroleum 269

Sorbitol 401G
Stabilizers 401H
Sulfur dioxide R321
Surface active agents 127, 401I
Surfacant selectors 402A
Surfacants 402B
- Nonionic 143

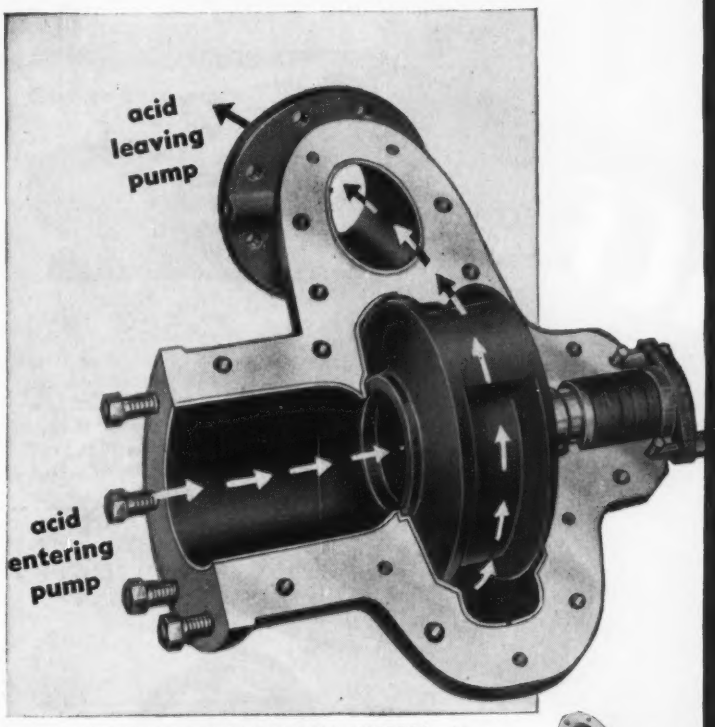
Tetrachloro phthalic anhydride...57g
Tetra-2-ethylhexyloxysilane 402C
Tolyne di-isocyanate 402D
Toners, tungstate & molybdate..402E
Trichlorethylene 57f
Urea, crystal 402F
Urea peroxide 402G
Waxes, polyethylene.....402H
Wetting agents 402I
Zirconium 402J

Equipment

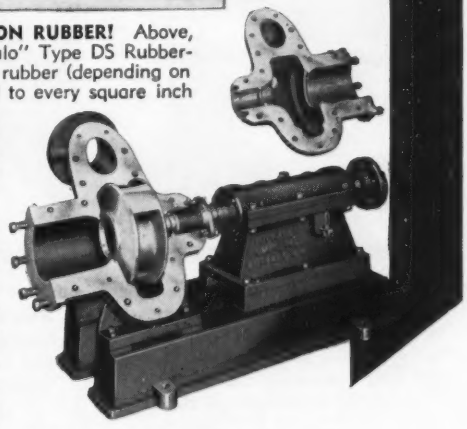
Absorbers, catalog S-7460.....227f
Vapor, bulletin SC-1047.....52c
Agitators, bulletin 76 .....153a
Agitators & mixers, bulletin A2-B4 .....404a
Alloys 402K, 402L
Cast 403A
Stainless steel brazing 403B
Analyzer-recorders, product specs. E64-1 & E12-5 74
Bag closers, portable 242E
Bags, multiwall 310
Bearings & bushes, teflon, bulletin CP554 .....L423
Bellows 307b
Belts, conveyor, woven wire 324
Blankets, insulating 327
Blenders 131
Dry, bulletin 78 .....153f
Twin shell, catalog 12 105
Blowers 303
Welded TL409
Blowers & exhausters, centrifugal.402
Boilers 261
Packaged 241b
Borescopes BR419
Burners, sulfur 236C
Cables, cathodic protection, bulletin DM5450 19
Cans
Seamless metal 406A
Utility 337
Caps, bubble 238C
Castings, high alloy, bulletin 3354-G 417
Cement, insulating 42
Centrifugals BR373
Centrifuges, high speed 121
Classifiers, bulletin C5C-B.....404c
Coatings
Concrete 408
Copper-porcelain finish 148H
Protective 403C, 403D, 403E, 403F
Cocks, sleeve-packed 237c
Compressors.314, 418A, 420A, 420B
Air-cooled 246C
Oil-free, bulletin A-44 8
Steam-driven 151
Concrete, rubber-base 142B
Conductors, bus 58
Connectors, coupling, bulletin 23-E 395a

ACIDS CAN'T CORRODE
WHAT THEY CAN'T TOUCH

THAT'S WHY BUFFALO RUBBER-LINED PUMPS SAVE MONEY



ACIDS, ABRASIVE SOLIDS RIDE ON RUBBER! Above, showing path of liquid thru "Buffalo" Type DS Rubber-Lined Pump. Hard, medium or soft rubber (depending on liquid to be handled) is vulcanized to every square inch of impeller and inside of casing. Extra cost of rubber lining is made up for, over and over, in longer pump life, maintenance savings and avoiding of shutdowns.



THE "BUFFALO" Q FACTOR* — A PERFORMANCE BONUS. The easily removed upper casing half of the Type DS Pump shown — its high efficiency impeller — overall sturdiness of casing, shaft, oversize bearings with large oil reservoir and ample stuffing box — all mean a best pumping buy. **WRITE FOR BULLETIN 982**—see the full line of proven "Buffalo" Pumps for every chemical liquid ready to start saving money for **you!**

*The "Q" Factor — the built-in Quality which provides trouble-free satisfaction and long life.

"Buffalo" PUMPS

Buffalo Pumps, Inc.

501 Broadway Buffalo, N. Y.

Subsidiary of Buffalo Forge Company

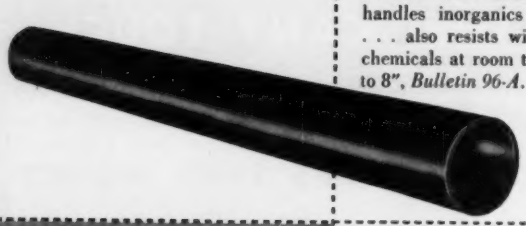
Canada Pumps, Ltd., Kitchener, Ont.

Sales Representatives in all Principal Cities

A BETTER CENTRIFUGAL PUMP FOR EVERY LIQUID.

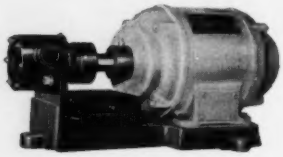
FOR HOT CORROSIVES:
ACE TEMPRON

Heat-resistant nitrile hard rubber pipe handles inorganics at 250-275 deg. F. . . . also resists wide range of organic chemicals at room temperature. Sizes 1" to 8", *Bulletin 96-A.*

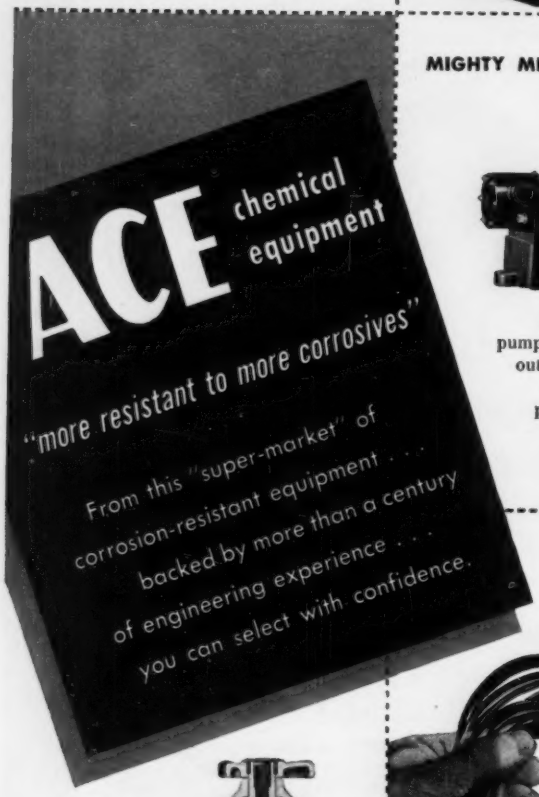


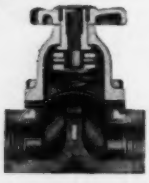
MIGHTY MIDGET

for pumping acids



Jabsco neoprene-impeller pump made of Ace hard rubber outlasts, out-pumps anything in its pressure, size and price class. Capacity from 15 gpm. at 22 ft. head to 5 gpm. at 72 ft. head. *Bulletin 97-A.*

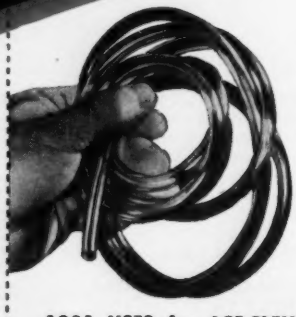

ACE chemical equipment
"more resistant to more corrosives"
From this "super-market" of corrosion-resistant equipment . . . backed by more than a century of engineering experience . . . you can select with confidence.



VALVES

for all-plastic piping systems

Trouble-free plastic diaphragm valves . . . choice of general-purpose rubber-plastic blend, Ace Parian (polyethylene) or Ace Saran. Handles most corrosive chemicals and food ingredients. Sizes ½" to 2", 50 psi. at 77° F. *Bulletins 80 and 351.*



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Excellent chemical-resistant, all-purpose flexible plastic tubing. Sparkling clear, easy to clean, odorless, non-toxic, can be steam-sterilized. ⅛" to 1" ID. *Bul. 66.*

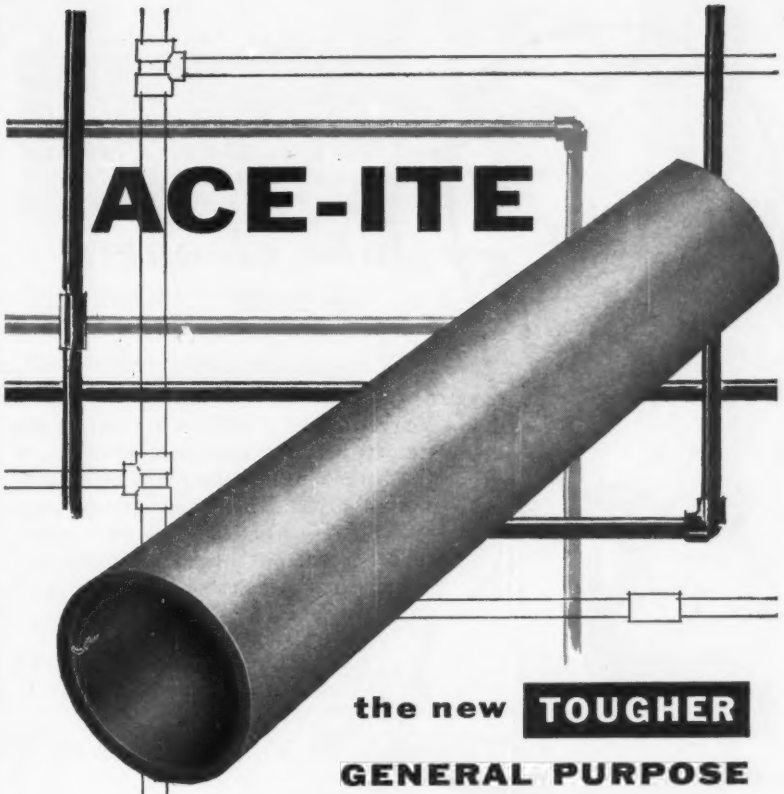
ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.

PRODUCT INDEX . . .

Containers
Carbon black 242F
Metal 406B
Plastic lined 242C
Controllers
Liquid level 99
Pilot, thermostatic 78-9a
Controls, float TR372
Conveying systems, pneumatic..351
Conveyor-elevators, bulletin 349..280
Conveyors 406C, 406D
Natural frequency 77
Screw, data 2287 13
Vibrating 242D
Coolers, cascade 248D, 407E
Catalog S-6820 .....227e
Coolers & slakers 16g
Couplings 22
Elbow 412E
Quick-seal 413A
Tank-car 246B
Crushers 238A, R319
Gyratory
Primary 16d
Secondary 16e
Jaw
Bulletin 1124 .....16a
Bulletin C12-B12 .....404d
Crystallizers 129b
Cyanide handling 406E
Dampers, pulsating 248C
Dealkalizers 415D
Dehumidification equipment ..407F
Dehydrators, bulletin SC-1013 ..52a
Demineralizers 415E
Detectors, fire 250D
Disks, pelletizing 236B
Drives 404B
Adjustable speed 404C
Power 435
Variable speed, bulletin 932..436a
Drums, magnetic, bulletin B-601.71a
Dryers-blenders, glassed steel ..436b
Dryers-coolers, bulletin 07B6368.223
Dryers 416
Bulletin D4-B2 .....404j
Absorptive, bulletin D-29 239
Coolers & roasters 60
Lectrodryer 264
Rotary, hot air, catalog "A".BL321
Spray 416A
Steam tube, bulletin 16-D-11 ..397
Tunnel truck 418
Vacuum, catalog 720 & bulletin 640 155
Drying systems, flash, catalog 54-A 294
Dust collectors 416B
Bulletin 1035 .....BL372
Centrifugal 150
Cloth flat bag 311
Cloth tube, bulletin 372.....354
Water wash TR419
Elbows, reducing, catalog 54....343
Elevators, manlift 406F
Evaporators 277
Downflow 217

Horizontal tube 129c
Evaporators & preheaters, milk .416C
Fabrications
Alloy TL411
Heat exchanger, bulletin 250 .302
Metal 306
Catalog 554 119
Process equipment, catalog 1810 84
Fans
Bulletin F-102 56
Bulletin 702 158
Bulletin DB-4-52 207
Axial 98
Centrifugal 420C
Grinding & mulling, bulletin 5-A 153g
Stack & duct boosters, bulletin 109-A 153c
Feeders, bulletin F6-B9 .....404e
Apron & grizzley 16f
Belt gravimetric 406G
Chemical 407a
Chemical solution, dry materials, bulletin 45-H8 331
Rotary, airlock 429
Scale 399
Filteraids, diatomite 360
Filter Felts 236A
Filters BL409
Bulletin F9-B2 .....404f
Continuous pressure 247
Horizontal plate 340
Powder R371
Rotary leaf, pressure 129a
Filters & evaporators 94
Filtration 141
Fire extinguishing systems, carbon dioxide 244D, 296, 415
Fittings 237a, 246D
Forged steel, bulletin A3-50 ..285a
Stainless, bulletin S-3-55 ....285b
Alloy, bulletin S-1-55 ....285d
Flotation, bulletin F10-B81 ...404g
Fuses 404D, 405A
Gages, tank TL374
Gages & valves, liquid level L325
Gaskets, catalog PK-35A 328
Spiral-wound 292
Generators R370
Steam 408A
Gloves, industrial 244C
Grinding & blending systems 85
Grinding machines 211b
Hangers, spring 18
Heat exchangers 278, 408B
Catalog S-6740 .....227c
Bulletin 521 .....241a
Glass 248B
Impervious graphite, catalog S-6800 252-3
Heat transfer equipment ..54-5a, 358
Heaters
Air lit. H54-15 .....L419
Direct fired 414
Electric screen 408C
Unit 86



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the new TOUGHER GENERAL PURPOSE PLASTIC PIPE

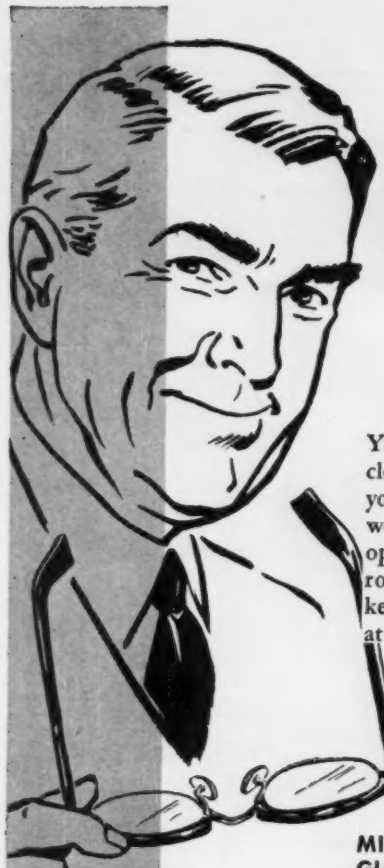
ACE-ITE is a new moderately priced rigid plastic pipe with exceptional impact strength and toughness . . . handles most corrosive fluids in your plant at moderate temperatures and pressures.

For piping most inorganic acids, salts, alkalis and many organic chemicals, it's the equal of plastics that cost far more. ACE-ITE maintains good strength, rigidity and chemical resistance from minus 40 deg. F. to 170 deg. F. Light in weight, it is odorless, tasteless, non-contaminating. Saves cost of painting, immune to electrolytic corrosion and bacteria. Available in pipe sizes from ½" to 6", standard and extra-heavy, with wide variety of fittings.

ACE-ITE is only one of eight types of rubber and plastic pipe now offered by American Hard Rubber Company. Write today for free technical Bulletin 80.

ACE rubber and plastic products

AMERICAN HARD RUBBER COMPANY
93 WORTH STREET • NEW YORK 13, N. Y.



Don't overlook AIRETOOL tube cleaners

as SURE maintenance cost-cutters!

You're missing a sure bet for having the cleanest boiler or condenser tubes . . . if you haven't put Airetool tube cleaners to work for you. These high-quality, easy-operating cleaners will whisk away profit-robbing scale in a matter of minutes, keeping loss of valuable production time at a minimum.

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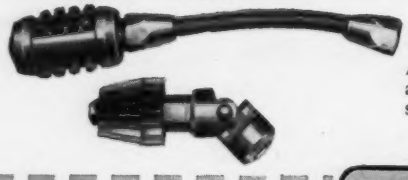

BRUSH, CLEANER HEADS FOR EVERY PURPOSE

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MANUFACTURING COMPANY

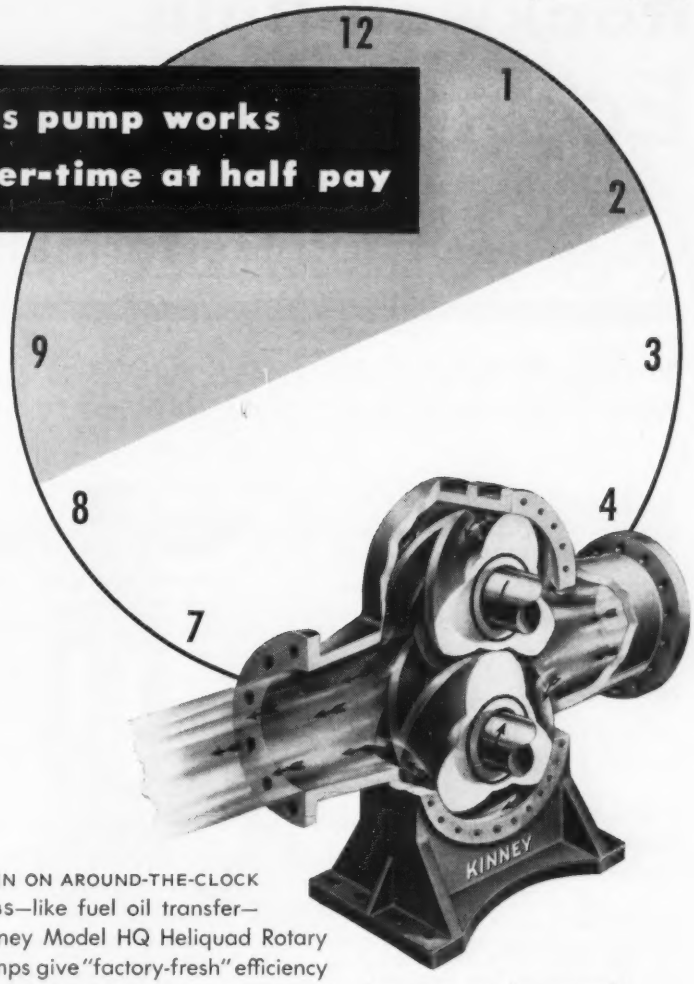
SPRINGFIELD, OHIO

PRODUCT INDEX . . .

Heating systems, hot water 408D
Heating tapes 408E
High pressure equipment. catalog 406 . . . . . .TL370
Hoists, portable skip. 242A
Homogenizers 334
Hoses
Fire 244B
Metal, catalog 147 403
Flexible, bulletin 20D 26
Suction & discharge 92
Humidity conditioning 40
Indicators
Dew point R421
Level 237e
Instrumentation 160-1
Instruments, spectrometer 257
Insulation
Fiberglas 344
Industrial 284
Pipe, bulletin 109C 82
Block 43
Glass fiber, bulletin 80-55. 273
Ion exchangers 245
Joints
Flexible, bulletin 28 300
Swivel 265
Joints & couplings, bulletin FC-952 299
Joints & packings, compressed asbestos sheet 237d
Kettles 305b
Kilns, rotary, bulletin 1115 . . . .16b
Laboratory equipment BL370
Bulletin LG3-B10 . . . . . .404i
Laboratory & pilot plant equipment, bulletin 77-A 153i
Linings, protective 346
Liquids handling equipment . . .407A
Lubricators, force feed 407b
Magnets 71b, 407B
Materials of construction, clad steel 156a
Materials handling 48
Bulk 64-5
Meters 410A, 410B
Flow TL321
Open channel 410C
Mercury vapor 412A
pH 412B
Mills
Ball, bulletin B2-B13 . . . . . .404b
Pebble, bulletin 100 . . . . . .153h
Colloid TR373
Grinding, bulletin 8121 . . . . . .16c
Ring-roll 211c
Swing-sledge 211e
Mixer bowls 309

Mixers. 157, 201h, 281, BR325, 417A
Data sheet B-107 ..... 201a
Bulletin 800 313
Catalog series 26 ..... 345a
Centrifugal 417B
Continuous, bulletin A 153K
Dry batch 211a
Laboratory, catalog B-112 ... 201g
Pipeline 417C
Portable 345b
Bulletin 74-A 153b
Catalog B-108 ..... 201b
Side drive, bulletin 532 342
Side entering
Bulletin 72-A 153c
Catalog B-104 ..... 201c
Top entering
Bulletin 73 ..... 153d
Catalog B-102 ..... 201c
Propeller type, catalog B-103 ..... 201d
Side entering 345c
Turbine 345d
Water
Hot-cold 78-9c
Steam 78-9d
Mixing & extruding machinery, bulletin 62-A 153j
Motorpumps 297
Motors 405B, 405C
Bulletin MU-202 154
Corrosion-resistant 232-3
Totally-enclosed, fan-cooled, bulletin 51B7149 76
Vertical 405D
Nickel, corrosion resistant 366
Nozzles, spray BL319
Catalogs 6-A & 6-C R323
Ovens 406
Packings 27
File DMCE TL319
Expanded, metal tower 234A
Ring 405E
Pails, steel 31
Panels
Connector, bulletin 23-E.... 395b
Pulsating 396
Pans 305c
Pigments, aluminum 341
Pilots, pressure 250A
Pipe & fittings
Catalog S-7000 ..... 227b
Glass 361a
Pipe, fittings & valves 356
Pipe, installation, glass 361b
Pipes
Hard rubber 390c
Plastic, bulletin 80 391

this pump works over-time at half pay



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for LOW COST High Performance

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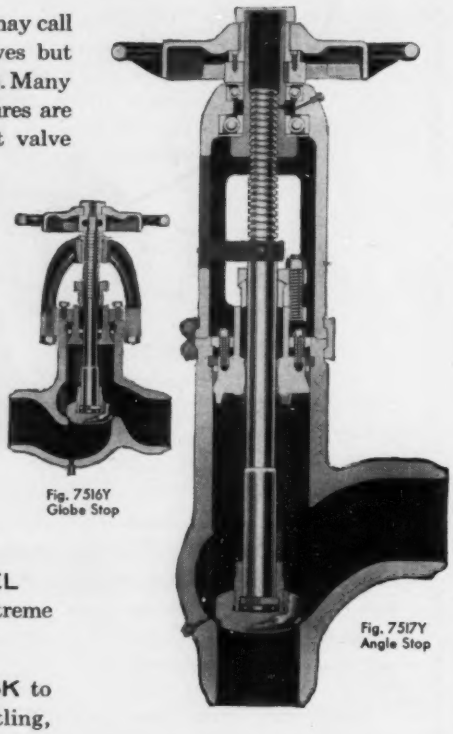

Fig. 7516Y Globe Stop

Fig. 7517Y Angle Stop

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INTERNALLY STREAMLINED BODY for minimum flow resistance,

IMPACTOR HANDWHEEL for tight shut-off under extreme pressure,

GUIDED STELLITED DISK to eliminate vibration in throttling,

INTEGRAL STELLITE SEAT for wear resistant sealing,

IMPROVED EDWARD PRESSURE-SEAL for leakproof bonnet joint.

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Always specify Edward. Only Edward Valves Equal Edward Quality and Performance.

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Subsidiary of ROCKWELL MANUFACTURING COMPANY

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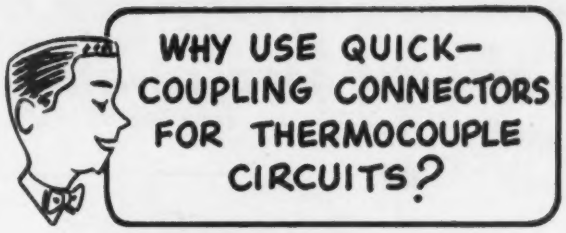
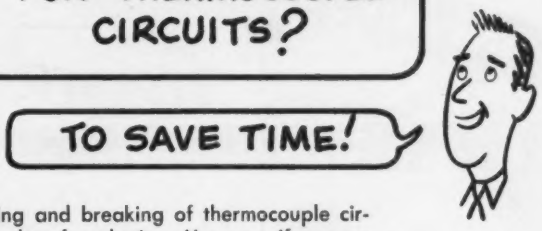
PRODUCT INDEX . . .

Saran lined 90
Platecoils, bulletin P61 30
Platinum, gold & silver, folder C-20 312
Potentiometers 412C
Preheaters, air 209
Presses, filter BL421
Pressure systems 250B
Processing equipment 305a
Impervious graphite 227d
Processing, air-gas 52b
Pulleys, magnetic, bulletin 501..71c
Pumps
Catalog 5-7250 .....227a
Bulletin 725.4 347
Bulletin 30CP 348
Bulletin UP-54 426
Acid 73
Bulletin 97-A 390b
Centrifugal 420D, 422A
Sealess, bulletin 1010 88-9
Controlled volume 422B
Double-suction, bulletin 08B6146 95
Horizontal, bulletin C-355 .R423a
Liquid, bulletin L51 393
Process, bulletin 1125-B 46
Propeller, bulletin 203-6.....420
Rubber-lined, bulletin 982 ...389
Screw 405
Self-priming, centrifugal, bulletin G-1 235
Sump, bulletin 4600-A 316
Vertical, bulletin V-837 ...R423b
Reactors 41, 162
Glassed steel 436b
Recorders, temperature TR325
Rectifiers
Excitron 39
Pumpless, bulletin GEA-5689.62-3
Reducers, speed 362b
Reduction units, speed 405F
Regulators 412D
Pressure 250C
Temperature 78-9b
Reproduction materials 61
Rims, sprocket TL372
Rubber, butyl 243
Rubbers, synthetic 146B
Saddles 102
Screens, vibrating, booklet 2554...97
Scrubbers, polyethylene 238B
Seals
Floating vapor 240A
Mechanical, bulletin MS-954..315
Rotary, mechanical, catalog B-111 .....201f
Separators 308

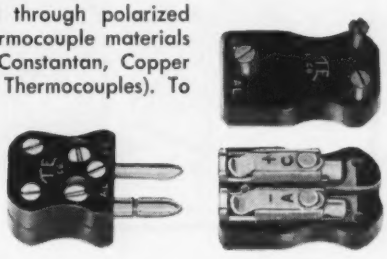
Air 59, 211d
Magnetic 407C
Catalog C-5000-B 50
Signs, accident prevention 244E
Spectrometers, brochure CEC 1800-X15 317
Starters 287
Steels TL421
Clad 156b, 404A
Nickel plated 266-7
Stainless.....49, 80, 224-5, 276
Strainers, fire screen, bulletin S-204 81
Suits, protective 244A
Tables, bulletin T1-B3 .....404h
Tandem units, vertical & horizontal, bulletin 498 422
Tank cars
Aluminum 215
Flued-dome 51
Tanks
Stainless steel bulletin PF 72
Storage, compartmented 240B
Tanks & reactors 54-5b
Teflon products 307a
Thermometers 330
Industrial 336
Titanium 338
Tools, pilot plant 238D
Towers
Cooling 362a
Data sheet 700 (1) 68
Water cooling 9
Tracto-loaders 251
Tractor-shovels 53, 242B
Transmitters
Bulletin 13-11 44-5
Pneumatic, data book 1004....100
Traps 268
Trays 322
Industrial, Catalog 953 83
Trucks, pallet 407D
Tube cleaners 392
Tubes
Alloy, copper-base 212-3
Cabled 255
Condenser 96
Copper 270
Dall-flow, bulletin 115-L1 137
Finned 248A
Tubing
Flexible, stainless steel, bulletin STC-1 283
Plastic, bulletin 66 .....390d
Stainless steel 286
Tubing & pipe, stainless steel....101
Turbines
High-speed 365
Steam, bulletin 135 75





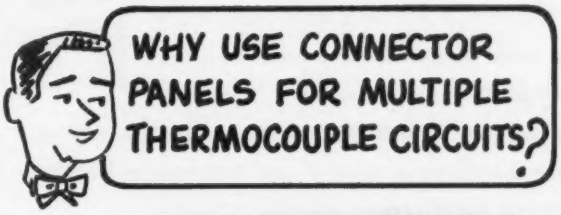
Frequent making and breaking of thermocouple circuits can take a lot of costly time. However, if you use T-E plug-and-jack connectors, a circuit can be made as quickly and easily as plugging in a radio.

Electrical contact is established through polarized elements which are made of thermocouple materials (your choice for use with Iron Constantan, Copper Constantan or Chromel Alumel Thermocouples). To maintain good electrical connection, the mated plug and jack provide both long-wiping surfaces and spring-loaded contacts. The connectors have screw-fastened, insulated covers, colored and marked to indicate calibrations.

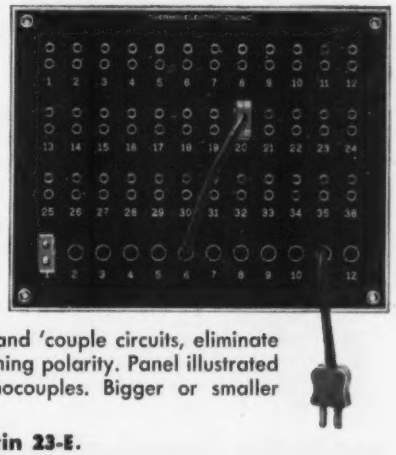


PAT. PEND.

Interested? Write for Bulletin 23-E.



By connecting all thermocouple circuits through central points, such as T-E's connector panels, you can save time in 2 ways. (1) Check instruments or thermocouple circuits from one or more centrally located distribution panels. With plug-and-jack connectors, test instrument is easily and quickly tapped into any circuit. (2) Transfer multiple thermocouple circuits. The panel's quick-coupling connectors permit rapid making and breaking of instrument and 'couple circuits, eliminate splicing time and avoid mis-matching polarity. Panel illustrated takes 12 pyrometers, 36 thermocouples. Bigger or smaller panels, if you want 'em.



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Pyrometers • Thermocouples • Protection Tubes • Quick-Coupling Connectors
Thermocouple and Extension Wires • Resistance Bulbs • Connector Panels

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Assure constant material flow from your bins and hoppers with . . .

PneuBin is a new concept in material flow engineering. The PneuBin unit consists of steel-backed, neoprene, pulsating panels, strategically located on the inside walls of your present bins. Working off the plant's regular air supply, PneuBin is inflated and deflated in controlled cycles, causing the contents of the bin to be "positively displaced" and thus assures free flow of material through the discharge opening.

■ ***DEPENDABLE***

PneuBin is on the job *whatever* the material flow problem. PneuBin's principle of "positive displacement" moves the bin contents, not the bin . . . assures constant, free-running material discharge. *Depend on PneuBin to insure material flow.*

■ ***SAFE***

No manpower is needed to facilitate material flow from bins when PneuBin is on the job. No more prodding, poling or sledge-hammering. *Depend on PneuBin to insure material flow . . . safely.*

■ ***ECONOMICAL***

PneuBin cuts maintenance costs, saves money year after year. Reduce bin damage . . . increase bin life. *Depend on PneuBin to insure material flow . . . safely, economically.*

■ ***QUIET***

PneuBin pulsating panels breathe . . . not snore. No hammering or loud vibration noises. PneuBin's quiet operation adds to overall plant efficiency . . . reduces employee fatigue. *Depend on PneuBin to insure material flow . . . safely, economically, quietly.*

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GEROTOR MAY CORPORATION

1525 Maryland Ave., Baltimore 3, Maryland

PRODUCT INDEX . . .

Unions, forged steel, bulletin U-1 . . . . . 285c
Valves 249, 394, 414A
Bulletin 255 350
Acid pressure 246A
Butterfly 401
Drain BL323
Gate, bulletin 5003 320
Motor 78-9c
Motor, diaphragm 123
Packless, diaphragm, folder AD-1942 293
Piston 237b
Plastic, diaphragm, bulletin 351 . . . . . 390a
Porcelain 271
Solder & Socket end 279
Solenoid 415A, 415B, 415C
Steel, catalog 20 282
Steel plug, catalog 54-1-W 353
Valves & fittings, freon & ammonia catalog O 412
Vaporizers, dowtherm, bulletin ID-54-S 133
Ventilating units 422C
Vessels
Knockdown 54-5c
Pressure 67, 54-5d
Viscometers 413
Washers
Fume, bulletin 9B 410
Log, bulletin WLO-1253 318

Services

Accident prevention signs 422D
Arched wafer service TR374
Brine making process 422E
Chemical cleaning 87
Construction, process plants 37
Design & construction 115
Anhydrous ammonia 2
Sulfuric acid 329
Electrolytic regeneration of spent pickling solutions 423A
Engineering & construction 117
Chemical 332
Foundry service 427
Plants
Chemical 423B
Packaged pilot 423C
Process plants, ammonia 259
Refining 423D
Safety practices 423E
Testing laboratory, mobile ore . . 423F
Wastes, industrial 423G
Water sites, industrial 17
Water treatment 219

Flashback

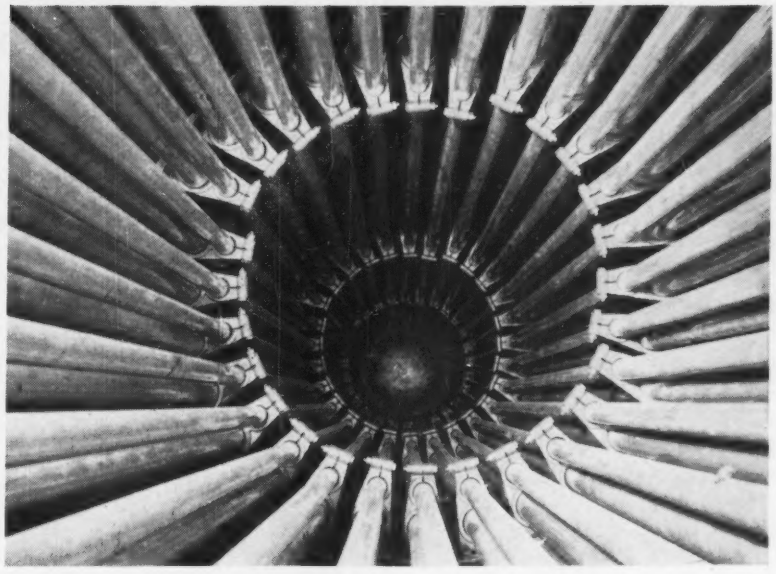
To make sure that you don't miss any news that could help you with your job, Chemical Engineering is doing a double take for you. The index below repeats the editorial listings only on chemicals, equipment and service featured last month in New Equipment and in Chemicals and Raw Materials. Use the postcard (p. 431) for more information on any items.

Chemicals

Acid, isosebacic 146A
Acrylic paint 140A
Catalysts, low-density 148F
Chemicals, fermentation 148A
Detergents, non-ionic 148J
Dyes, acetate 148C
Elastomers, acrylate-type 148D
Musk, synthetic 148B
Oils, rust inhibitor 148H
Polyethylene 144B
Refractory, thin silicon carbide..148G
Silica gel, pre-attrited type.....144A
Silicones, spraying 146B

Equipment

Agitators 280C
Analyzers
  Infrared 284B
  Portable oxygen 284A
Condensers, evaporative 282A
Control systems, automatic 284D
Dampers, slide 282D
Drives, agitator 280A
Dryers, single drum 282E
Engines, power 290B
Filters
  Pressure 280D
  Small 278B
Fittings, stainless steel 286A
Fuses, silver-plated 290D
Heads, reflux, automatic 278C
Heat exchangers, fin-tube.....282C
Heat transfer apparatus..278A, 282B
Lighting systems 290C
Metals, clad 276A
Meters, flow 284C
Nylon 148E
Plastic 286D
Pump motor, ball-type, non-reverse ratchet 290A
Pumps, canned motor 286C
Rayon fiber, industrial 148I
Rerollers, drum 288B
Samplers, pipeline 280B
Scanners, indicating 284E
Seals, lubricated 290E
Silicon carbide shapes 274A
Telephones, portable 288C
Tube bundle pushers 288A
Tubing, nylon 286B
Valve service, mobile 288E
Welding systems, arc 288D



Ruggles-Coles STEAM TUBE DRYERS

- Ruggles-Coles Steam Tube Dryers have been supplied fabricated of aluminum, nickel, monel, inconel, stainless steels and other alloys to provide protection against corrosion and contamination. All fabrication is to code requirements.
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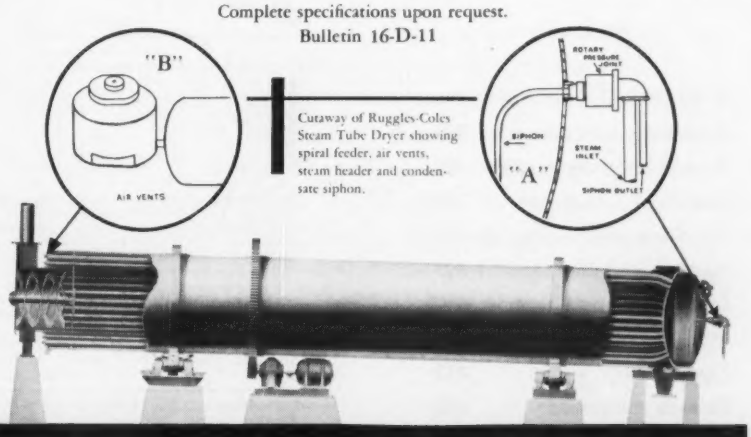
Complete specifications upon request.
Bulletin 16-D-11



Cutaway of Ruggles-Coles Steam Tube Dryer showing spiral feeder, air vents, steam header and condensate siphon.

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For More Information . . .

You can get—and get fast—more information on any publication listed in this guide by using the Reader Service postcard inside the back cover. Simply circle the item's code number on the postcard, fill in your name and address, then mail to us. Ask for as many as you need. Answers come to you direct from the companies putting out the literature.

Contents of This Issue . . .

Chemicals and materials 398
Construction materials.. 402
Electrical equipment .. 404
Handling and packaging 406
Heating and cooling.... 407
Instruments and controls 410
Mechanical equipment.. 404
Pipe, fittings, valves.... 412
Process equipment 415
Pumps, blowers, compressors 418
Services and Processes.. 422

Chemicals

Acid, Adipic.....The properties and reactions of adipic acid, including a literature survey of 80 applications for the versatile resin intermediate, are detailed in a new 36 p. reference. Technical Bulletin O-105.
398A Monsanto Chem. Co.

Acid, Barbituric.....Properties: molecular weight—128.09; melting point—decomposes at 245°C±; solubility—soluble in hot water, slightly soluble in alcohol, soluble in ether. Technical Bulletin available.
398B Kay-Fries Chem.

Acid, Benzoic, Technical.....Develops a bead form of benzoic acid, technical. These tiny benzoic acid beads keep their shape during handling, right up to the time they go into process. Request Data Sheets.
152a *Hooker Electrochem. Co.

Acid, Citric.....Important chemical in many metal cleaning pastes & liquid formulations for both home & industrial use. Data in "Ammonium Citrate & Citric Acid in Scale & Rust Removal," Bulletin No. 15.
363a *Chas. Pfizer & Co.

Acid, Itaconic.....20 p., paper bound, index-type technical bulletin outlines uses & properties of itaconic acid—a versatile organic compound made in commercial volume by fermentation. Request Booklet No. 82.
398C Chas. Pfizer & Co.

Acid, Naphthenic.....12 p. Technical Bulletin includes: chemical & physical properties; uses of naphtenic acids & derivatives (as driers for paints & varnishes, as fungicides, as emulsifying agents, etc.).
398D Oronite Chem. Co.

Acid, Oxalic.....Because Pfizer oxalic acid solubilizes iron oxide, it is chief ingredient in radiator cleaning compounds. Company makes available complete information in detailed Technical Bulletin No. 34.
363b *Chas. Pfizer & Co.

Acid, Peracetic.....New technical booklet describes efficient hydrogen peroxide-resin technique. Request "Hydrogen Peroxide-Resin Technique for the Preparation of Peracetic Acid." Bulletin P 63-355.
398E E. I. duPont de Nemours.

Acid, Phosphomolybdic.....Releases descriptive literature—"Preparation of Phosphomolybdic Acid from Phosphoric Acid and Pure Molybdic Acid." Details laboratory method of producing phosphomolybdic acid.
398F Climax Molybdenum Co.

Acid, Propionic.....Eastman acids & anhydrides have been called "the standard of the industry." Propionic acid features valuable application in organic synthesis. Offers detailed information & product samples.
398G Eastman Chem. Products.

Acid, Stilbenedicarboxylic . . . . . Announces a 24 p. technical bulletin covering Oronite stilbenedicarboxylic acid. Includes data on properties, chemical reactions, numerous uses, etc. Request Bulletin No. 8 (7-50).
398H Oronite Chem. Co.

Acids, Fatty.....24 p. booklet offers specifications, grades, packing & stock points on distilled stearic, oleic, coconut, cotton seed, soya & palm fatty acids. Request "Fatty Acids in Modern Industry."
398I A. Gross & Co.

Acrylonitrile.....Reacts with halogens & pseudohalogens under mild conditions to give a number of interesting & reactive compounds in fair to good yields. For detailed information, request Technical Bulletin PD5.
398J American Cyanamid Co.

Algicides.....Oronite Algicide ATM-50 is a convenient & effective reagent for the control of biological fouling in industrial cooling water systems. Data, properties & analytical methods in Bulletin (Cationics A-2).
398K Oronite Chem. Co.

Alumina Trihydrate.....Commercial, organic free alumina trihydrate—a pure, snow white hydrated alumina, free from contaminants. A low-cost source of soluble alumina. Information and product sample.
398L Reynolds Metals Co.

Amines, Aliphatic.....More than 400 original literature sources were used to develop sections on applications, chemical reactions, toxicology & physical properties of amines, in 52 p. book, "Sharples Amines."
398M Sharples Chem.

Amines, Dimethyl Tertiary.....Descriptive reference covers: solubility; typical analysis of tertiary amines; reactions of tertiary amines; applications for tertiary amines; etc. Request 6 p. Technical Bulletin No. B-2.
398N Armour Chem. Div.

Ammonium Persulfate . . . . . Company makes available on request a literature reference covering line of ammonium persulfate. Includes data on chemical & physical properties, uses & handling. Product Bulletin No. 49.
398O Buffalo Electro-Chem. Co.

Amyl Acetates, Primary.....Physical properties, specifications & shipping data, uses, resin solubilities & data on performance of primary amyl acetates in nitrocellulose lacquers discussed in Bulletin F-8911.
398P Carbide & Carbon Chem.

1, 4-Butanediol.....Reacts as dihydric alcohol. Chemical intermediate for polyesters, polyurethanes, polyamides & cyclic compounds. For use in plasticizers, resins, fibers. Technical information & product samples.
398Q General Aniline & Film Corp.

Butyl Oleate.....Witco butyl oleate has been found to be the best and most economical plasticizer for use in Neoprene Type WRT. Includes complete information on properties in Technical Service Bulletin No. E-9.
398R Witco Chem. Co.

Calcium Carbonates.....Illustrated, 20 p. booklet, "Witco Witcarbs in Paints," offers valuable data on line of pure calcium carbonates. Includes features and the physical and chemical properties. Request Bulletin 54-3.
398S Witco Chem. Co.

Carbon, Activated.....Announces the availability of informative product literature—"How Seven Industries saved $150,000,000 a Year with Columbia Activated Carbon." Request 16 p. illustrated Booklet F-6658C.
398T Carbide & Carbon Chem.

Carbon, Activated.....Details uses, advantages, requirements, specifications & characteristics of activated carbon in purification of liquids, decolorizing, filtration & similar applications. Tech. Bulletin 13.
399A Barnebey-Cheney Co.

Carbon Black.....Company offers a 68 p. reference, "Witco Blacks in Natural and Chemical Rubbers," covering their product line of carbon blacks. Includes complete information on properties. Bulletin 54-1.
399B Witco Chem. Co.

Catalysts.....You benefit with Girdler catalysts: custom design matches your needs; technical service helps you save; quality control assures uniformity; etc. For complete information, request Bulletin G-260.
304 *Girdler Co.

Chelates.....Iron deficiency in plant life is present in nearly every region of the earth. Perma Green Iron 135 (most effective organic iron chelate for all soils) correct this iron deficiency. Illustrated, 12 p.
399C Refined Products Corp.

Chemicals.....8 p. folder, "Victor Chemical Works," outlines principal uses of products. Includes aluminum formate, aluminum phosphates, dicalcium phosphate, phosphoric acids, ferric phosphates, sodium formate.
399D Victor Chem. Wks.

Chemicals..... Illustrated, 40 p. bulletin, "Eastman Chemical Products" (Seventh Edition) includes data on product line of acids & anhydrides, alcohols, aldehydes, plasticizers, solvents, amines, phenols, etc.
399E Eastman Chem. Products.

Chemicals, Chromium.....16 p. booklet, Analytical Methods for Chromium Chemicals," contains the methods commonly employed for the analysis of the industrially important chromium chemicals. Request Serial 51.
399F Mutual Chem. Co. of America.

Chemicals, Fine.....Announces the new 1955 Products Book...a 266 p. illustrated guide to services, products and special facilities of the foremost producer of fine chemicals and laboratory reagents.
399G Baker & Adamson Products.

Chemicals, Laboratory.....New Merck Laboratory Chemicals Catalogue lists the more than 1,000 laboratory chemicals currently supplied by the company, including new solvents designed for spectrophotometric use.
399H Merck & Co.

Chemicals for Metal Finishing..... Chemicals of interest to metal finishers include: citric, tartaric, gluconic & oxalic acids, & their salts. Request Technical Bulletin 61, "Chemicals for Metal Finishing."
363e *Chas. Pfizer & Co.

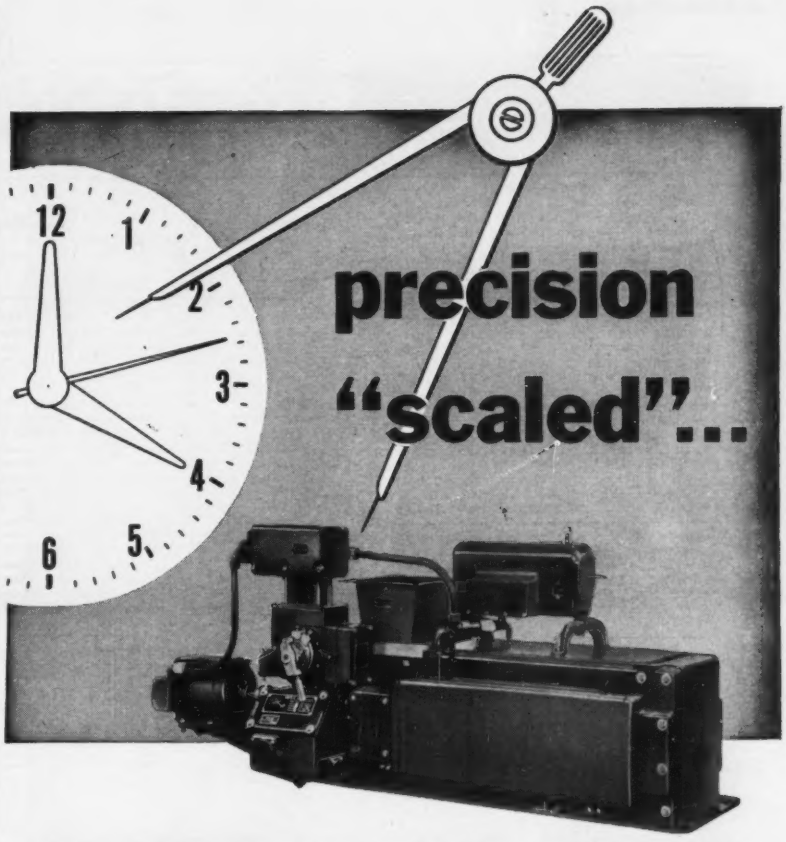
Chemicals, Reagent.....Matheson, Coleman & Bell's new product catalog, of over 100 p., listing more than 4,000 reagent chemicals, biological stains, chemical indicators & solutions will be sent to you upon request.
399I Matheson, Coleman & Bell.

Chemicals, Sodium Silicate.....New 20 p. booklet reviews complete line of specialized sodium silicate chemicals. Includes physical properties, industrial applications, basic advantages, size & net wt. of packages, etc.
399J Diamond Alkali Co.

Cryolite & Aluminum Floride.....Highest quality synthetic products. Feature valuable uses — ceramics... insecticides...fluxes. Company makes available detailed information in addition tc product samples.
399K Reynolds Metals Co.

Defoamers.....For more efficient foam control. Versatile defoamers save space now wasted on foam, cut the processing time, eliminate waste & fire hazard of overflowing foam, etc. Offers complete data & samples.
R409 *Dow Corning Corp.

*See explanation on p. 398



FOR MINUTE TO MINUTE ACCURACY

Minute to minute accuracy in the feeding of dry materials — uniform delivery to reaction tanks, continuous blending, or batch mixing — is a requisite for maintaining uniformly high quality in final products, in modern chemical processing operations.

W & T Merchen Scale Feeders which weigh and feed in one operation ensure this exacting accuracy. Precision "scaled", durably constructed and simply controlled, the Feeder weighs all material and immediately compensates by weight for variations in density, moisture content, etc. Whether feeding ounces or pounds per hour, the pre-set rate of feed is continually and automatically maintained.

If you have a processing problem requiring uniform feeding of dry materials, accurately controlled by weight, communicate with Wallace & Tiernan. You'll receive prompt attention without obligation.

M-21

WALLACE & TIERNAN
INCORPORATED

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Detergents.....In addition to bulking properties of its spray-dried form, Sulframin AB-40 imparts high foaming properties & excellent detergency to household & industrial cleaning products. Data & product samples.
400A Ultra Chem. Wks.

Detergents.....Now 150% active—Onyxol alkanolamides made by radically new process. Features: greater value —higher quality—more uniformity —better performance—etc. Literature and product samples on request.
400B Onyx Oil & Chem. Co.

Detergents.....Ultrawets in your shampoo formulation may help you to improve your present product. Superior alkyl aryl sulfonates are far less costly than many other types of detergents. Offers complete information.
400C Atlantic Refining Co.

Dialkyl Amino Alkyl Chlorides.....Specially prepared individualized intermediates—dialkyl amino alkyl chlorides provide a versatile group of intermediates for pharmaceutical synthesis. Technical information.
400D Michigan Chem. Corp.

2,6-Diethylaniline.....This promising o-Alkylaniline is suggested as a raw material for dyestuffs, pesticides, antioxidants and other organic products. Makes available product samples and Fact Sheets on request.
400E Ethyl Corp.

Di-Iso-Octyl Phthalate.....A high boiling stable liquid of low viscosity which has excellent resistance to ultra violet light. Performance data of DIOP in PVC, properties, etc. in Technical Service Bulletin E-7.
400F Witco Chem. Co.

Diluents.....Company announces the release of a fully illustrated, 8 p. reference describing their line of diluents, dispersing agents and stickers...for agricultural dusts and sprays. Request Bulletin No. 23.
400G R. T. Vanderbilt Co.

Dispersing Agents.....Describes line of Darvan dispersing agents: properties; what they do; how they work; which should be used; how much should be used; how should they be used; etc. Request Bulletin No. 13.
400H R. T. Vanderbilt Co.

Dispersions.....Company announces the availability of a list of "dag" dispersions for industry...colloidal graphite—zinc oxide—vermiculite—molybdenum disulfide—mica—colloidal acetylene black—etc.
400I Acheson Colloids Co.

Dispersions, Fluorocarbon Polymer..... 20 p. covers application techniques for Kel-F fluorocarbon polymer dispersions on metallic and non-metallic surfaces — spraying, spread coating, dip and flow coating, baking.
147 *M. W. Kellogg Co.

Emulsifiers.....Describes Witco DGO, a diethylene glycol oleate (diglycololeate) for emulsifying latex & resin emulsion paint systems. Outlines detailed typical properties. Technical Service Bulletin H-3.
400J Witco Chem. Co.

Emulsifying & Anti-Foaming Agents.....Applications in paint, cosmetics, metal working, plastics, textile, etc., industries for Witco DGL (a diethylene glycol mono laurate). Technical Service Bulletin No. H-2.
400K Witco Chem. Co.

Epichlorohydrin.....An intermediate for the revolutionary epoxy resins, as well as for a whole new family of dyestuffs, solvents, plasticizers, & adhesives. Information in Technical Booklet No. SC:49-35.
111 *Shell Chem. Corp.

Ethylene Polymer.....Illustrated Folder describes Marlex 50—typical characteristics, typical properties (typical electrical properties, film properties, permeability properties), numerous applications, etc.
400L Phillips Chem. Co.

Formaldehyde.....Because of its high order of chemical reactivity & low cost, formaldehyde is one of the most important basic organic chemicals in current industrial use. Properties & uses in Bulletin No. S-01-4.
400M Celanese Corp. of America.

Furfural.....“Physical Data on QO Furfural” presents graphs & tables of properties of QO furfural. Methods for recovery of furfural for re-use in chemical processes covered. Request Bulletin No. 203-A.
298 *Quaker Oats Co.

Gelling Agents.....(For oil well treating). Specially compounded salts (soaps) of fatty acids which have the ability to gel petroleum hydrocarbon solvents at room temperature. Technical Service Report No. G-4.
400N Witco Chem. Co.

Glycerine.....Offers valuable booklets including “Glycerine—Preferred for Product Conditioning,” which outlines properties that make glycerine preferable in conditioning toilet goods and pharmaceuticals.
339 *Glycerine Producers' Assoc.

Glycerine.....Dow Chemical will soon be on stream with commercial production of synthetic glycerine. Request an experimental sample from Dow, and evaluate the material and the quality in your own laboratory.
400O Dow Chem. Co.

Hydrocarbon, Hard.....Illustrated 56 p. reference, “Witco Hard Hydrocarbon M.R. #38) in Natural and Chemical Rubbers,” includes information on properties and mixing and testing procedures. Bulletin No. 51-1.
400P Witco Chem. Co.

Hydrogen Peroxide Vapor.....20 p. booklet covers: properties of hydrogen peroxide vapor; decomposition of hydrogen peroxide vapor; generation of hydrogen peroxide vapor; use, etc.
400Q Buffalo Electro-Chem. Co.

Iron Oxides, Red.....Reds—more of them . . . and better made. Included are pure red iron oxides—red iron oxides—venetian reds. For complete information on company's line, request descriptive literature.
301 *C. K. Williams & Co.

Isophorone.....Describes physical properties, specifications, shipping data, general solvent properties, constant-boiling mixtures, physiological properties and uses in a new reference. Technical Bulletin No. F-5897A.
400R Carbide & Carbon Chem.

Ketones, Aliphatic.....Stearone & Laurone are symmetrical higher molecular weight aliphatic ketones derived from their corresponding fatty acids. Data on compatibility, solubility, toxicity, properties, etc. Bulletin G-1.
400S Armour Chem. Div.

Latices, Concentrated..... Revertex brand presents natural rubber in its most versatile form. Outlines properties of concentrates & lists manufacturing processes in which they are commonly used in illustrated, 32 p.
400T Revertex Ltd.

Latices, Resin & Plastic.....Geon resin & plastic latices are being used today in textile & fabric, paper, electrical, leather & paint industries. Summarizes properties & applications in illustrated Bulletin No. L-4.
400U B. F. Goodrich Chem. Co.

Lithium Borohydride.....Offers technical information on lithium borohydride. Features valuable uses: organic reducing agent; hydrogenation agent; hydrogen generation; etc. Find complete details in Bulletin 402.
400V Metal Hydrides.

Lithium Chloride.....Data Sheet covers: molecular weight; color & form; density; melting & boiling points; solubility; density of aqueous solutions; typical analysis; grades & strengths; packing; uses; etc.
400W Lithium Corp. of America.

Methionine Energy Concept.....Presents an illustrated 10 p. background report covering methionine-energy relationship—specific application of a new nutritional concept to achieve maximum broiler feed efficiency.
400X E. I. duPont de Nemours.

Methyl Isobutyl Ketone.....Includes applications, physical properties, specifications, shipping data, general solvent properties, constant-boiling mixtures & physiological properties, in Bulletin F-8637.
400Y Carbide & Carbon Chem.

Molybdenum.....Company announces the availability of descriptive literature . . . “Reclaiming Acres with Ounces.” Includes information on molybdenum in land improvement, with special reference to acid soils.
400Z Climax Molybdenum Co.

Nitrate of Soda.....Coarse, medium or fine crystals, screened to suit your particular end use or process—whether explosives, meat packing, ceramic, dye making, food manufacture, etc. Request product samples.
400AA Nitrogen Div., AC&D.

Oils, White.....Penn-Drake white oils, petrolatums & odorless solvents are detailed in a new technical bulletin. Included are specifications and suggested applications for the various products. Bulletin No. 555.
400BB Pennsylvania Refining Co.

Pentachlorophenol.....Announces a revised and expanded technical reference which furnishes step-by-step directions for six “Analytical Methods for Pentachlorophenol and its Salts.” 36 p. Bulletin No. O-24.
400CC Monsanto Chem. Co.

Peroxide Bleaching Processes.....Three Becco peroxide bleaching processes which are of prime utility for bleaching, superbleaching and prevention of reversion of Southern woods are described in Bulletin No. 25.
400DD Buffalo Electro-Chem. Co.

Phosphating Compounds.....New pamphlet describes in detail the complete Turcoat line of phosphating compounds. Includes a phosphating reference chart. Request “A Better Bond . . . For Organic Finishes.” 4 p.
400EE Turco Products.

Piperazines & Pyrazines.....Compiles a 33 p. booklet containing excerpts from chemical literature. These excerpts relate to the reactions and applications of piperazines and pyrazines and their derivatives.
400FF Wyandotte Chem. Corp.

Plasticizers.....Company announces the availability of a valuable reference containing information on properties & uses of plasticizer line. Request “What You Should Know About Paraplex & Monoplex Plasticizers.”
400GG Rohm & Haas Co.

Polyvinyl Acetate Emulsions.....New Polyco 612 for maximum compounding versatility—the new “60% solids” anionic type PVA emulsion for coatings & adhesives that need a high solids compound. Data and samples.
400HH Borden Co.

Propylene Polymers.....Describes two high-quality commercial propylene polymers, Propylene Trimer & Propylene Tetramer. Includes specifications, molecular structure & other data. Technical Bulletin No. 20.
400II Sun Oil Co.

2-Pyrrolidone.....Polymerizes to high molecular weight, linear, nylon-type, polyamide condensation product. Gives g-aminobutyric acid and derivatives, also N-acyl lactams. Technical information and samples.
400JJ General Aniline & Film Corp.

Resins.....Cumar resin provides successful & economical solutions to production problems in a wide variety of industries. Illustrated, 64 p. covers uses, product data & properties, testing methods, etc.
400KK Barrett Div.

*See explanation on p. 398

Resins.....Exon 480—specifically for records. This Firestone resin provides unique production advantages in the blending, fusing, preforming and molding processes. Makes available descriptive literature.
15 *Firestone Plastics Co.

Resins, Casting.....Literature describes Epocast 4-B...a cream colored casting resin recommended when a hard surface is desired of the cast epoxy. For complete information, request Technical Bulletin EP-54-10a.
401A Furane Plastics.

Resins, Ion Exchange.....When you use Nalcite resins, you take advantage of Nalco's long and broad experience in water and process technology. Makes available complete technical information on Nalcite product line.
326 *National Aluminate Corp.

Resins, Laminating.....Epocast 4-B-2 is a cream colored laminating resin containing inert mineral fillers chosen to impart more tackiness to resin & develop greater surface hardness. Technical Bulletin EP-54-24.
401B Furane Plastics.

Silica, Colloidal.....Describes Cab-O-Sil—a new colloidal silica for use in the paint industry—as an antisettling agent, to modify flow properties, as a transparent extender, etc. Bulletin No. CPal-2.
401C Godfrey L. Cabot.

Soaps-Detergents.....Illustrated, 36 p. gives data on toilet & bath soaps, pumice & liquid hand soaps, packaged synthetic detergents, scouring cleansers, etc. "Handy Soap & Synthetic Detergent Buying Guide."
401D Colgate-Palmolive Co.

Sodium m-Silicate.....Valuable data on Drymet anhydrous—the most highly concentrated form of sodium m-Silicate. Drymet File Folder contains complete technical information and suggested formulations.
BL411a *Cowles Chem. Co.

Sodium Sulfate.....West End Chemical now is producing salt cake and anhydrous sodium sulfate at the rate of approximately 50,000 tons annually. Makes available upon request product samples and detailed literature.
159 *West End Chem. Co.

Solubilizers.....Describes Witco GMO, a glycerol mono oleate of the non-self-emulsifying type for dispersing or "solubilizing" alkyd resins in "odorless" paint systems. Request Technical Service Bulletin H-4.
401E Witco Chem. Co.

Solvents.....Assure controlled evaporation. In paint & surface coating industry . . . solvents offer precise characteristics to meet your most exacting requirements. Full data on characteristics & specifications.
269 *Esso Standard Oil Co.

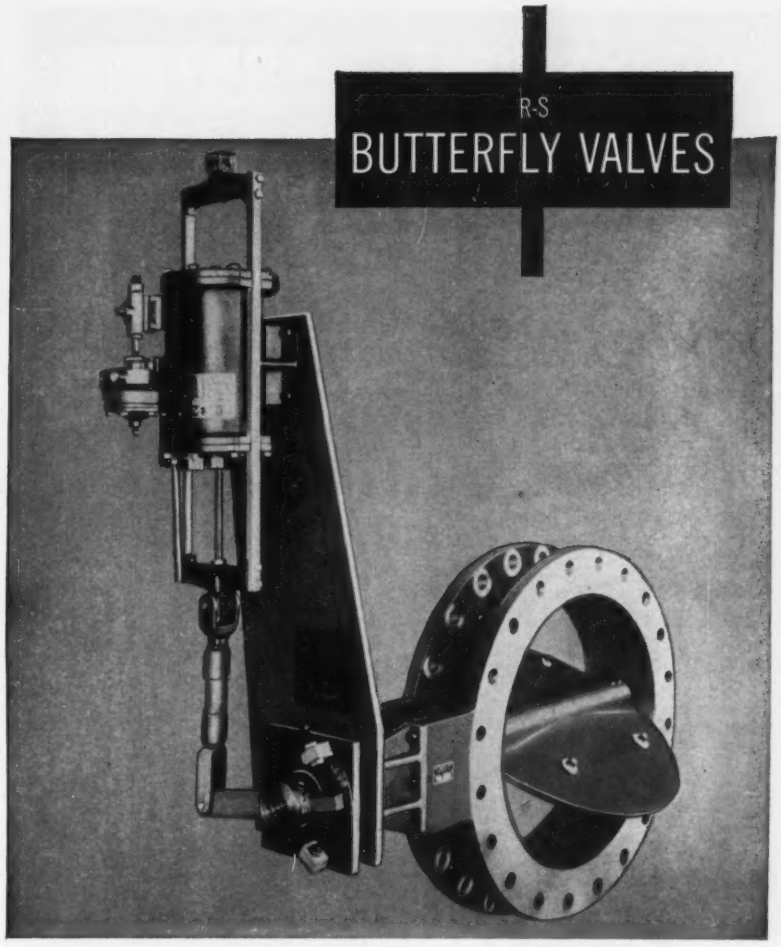
Solvents.....Bulletin describes line of Picco solvents and solvent oils—a complete series of aromatic petroleum napthas, coal tar napthas, heavy napthas, coal tar heavy napthas, solvent oils and heavy oils.
401F Pennsylvania Indus. Chem.

Sorbitol.....22 p. reference published by company reveals how manufacturers of confections and other foods can make use of the unusual qualities of sorbitol in their products. Request your copy of booklet, No. CD-83.
401G Atlas Powder Co.

Stabilizers.....Witco Stabilizer #80 is a high-efficiency, liquid stabilizer developed by company for polyvinyl chloride resins. Complete description & typical properties in Technical Service Bulletin S-6.
401H Witco Chem. Co.

Surface Active Agents.....Dispersant NI-O is an oil-soluble nonionic surface active agent specifically designed to give high detergency in those dry cleaning systems using any type of solvent. Bulletin No. 17 (8.52)
4011 Oronite Chem. Co.

* See explanation on p. 398



R-S VALVES FOR SENSITIVE CONTROL

These design features have won complete process control acceptance for R-S Butterfly Valves. In your processing system, an R-S Valve will give you every advantage in . . .

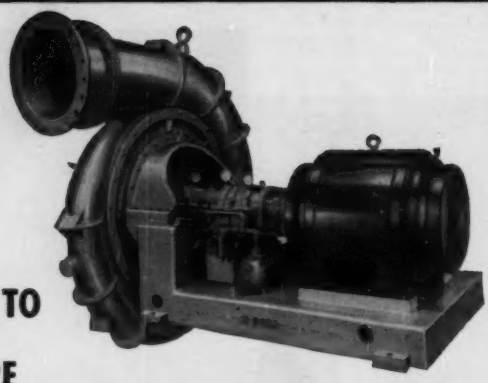
...complete control in all positions of normal regulating range
...fast regulation and control
...minimal pressure drop
...compactness and lightweight at less cost.

R-S Valves assure the most positive and dependable performance. They are available in any material that can be cast or welded.

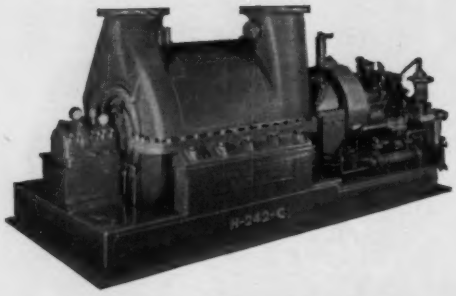
The complete line of SMS valves – butterfly, cone and ball – are backed by over 75 years experience in hydraulic design and engineering. For full information on the proper valve for your process problems, check with our local representative or write S. Morgan Smith Company, York, Pa.

Hydraulic Turbines
Pumps
Gates & Hoists
Trash Rakes
Accessories
HYDRODYNAMICS
Rotovalves
Ball Valves
Butterfly Valves
Free-Discharge Valves
Controllable-Pitch Ship Propellers

SMS S. MORGAN SMITH CO.
AFFILIATE: S. MORGAN SMITH, CANADA, LIMITED, TORONTO



POINTS TO COMPARE ABOUT R-C **Centrifugals**



CHECK THE R-C "BIG 4"

1. Variable capacities, with constant pressure at high efficiency.
2. Heavy, rugged construction... minimizing noise and vibration.
3. Adaptable to high-speed, direct-connected drives.
4. Low maintenance... long-time dependability.

Check your present blowers or exhausters—if they don't measure up, ask for suggestions from the R-C engineer.

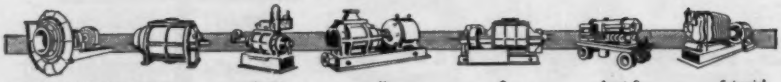
Long-time, reliable, economical operation of your Centrifugal Blowers or Exhausters calls for this combination of "BIG 4" essentials which can be obtained only in R-C equipment.

They apply equally well to R-C Single-Stage or Multi-Stage Units, in all sizes and capacities from 2,000 cfm to 100,000 cfm. You can select an R-C Centrifugal which is closely matched to your requirements. This usually results in lower first cost and reduced operating expense.

For new installations or for replacement of unsatisfactory equipment, we suggest you call in an R-C engineer for unbiased advice.

ROOTS-CONNERSVILLE BLOWER

A DIVISION OF DRESSER INDUSTRIES, INC.
855 Illinois Ave. • Connersville, Indiana



Centrifugal and Rotary Positive Blowers and Exhausters • Positive Displacement Meters • Vacuum Pumps • Gas Pumps • Inert Gas Generators • Spiroaxial Compressors

LITERATURE . . .

Surfactant Selectors.....Atlas HLB Selector helps emulsion formulator by providing a ready reference to recommendations on Atlas surfactants & HLB values for 96 typical emulsion formulas. Selectors on request.
402A Atlas Powder Co.

Surfactants.....Company makes available valuable 72 p. reference, "A Guide to Formulation of Industrial Emulsions with Atlas Surfactants." Includes information on the HLB System and on Atlas emulsifiers.
402B Atlas Powder Co.

Surfactants, Nonionic.....Carbide has developed a large group of Tergitol nonionics. Each one is carefully designed for maximum efficiency under specific conditions of performance. Literature & product samples.
143 *Carbide & Carbon Chem.

Tetra-2-Ethylhexyloxysilane....Describes properties of Orsil BF-1—a hydrolytically stable aliphatic silicate with unusually low pour point, good lubrication characteristics, etc. Request Bulletin No. 20 (10-52).
402C Oronite Chem. Co.

Tolylene Di-Isocyanate.....Nacconate 65—isomeric mixture of 65% 2,4-tolylene di-isocyanate and 35% 2,6-tolylene di-isocyanate. Product samples, detailed technical information and quotations upon request.
402D National Aniline Div.

Toners, Tungstate & Molybdate.....Releases a report on the preparation and testing of seven toners from each of ten different dyes using phosphomolybdic, phosphotungstic and phosphotungstic-molybdic acids.
402E Climax Molybdenum Co.

Urea, Crystal.....Purity and uniformity make it ideal for use in a large number of products and processes. Furnishes full details—specifications, chemical and physical properties, suggested uses, etc.
402F E. I du Pont de Nemours.

Urea Peroxide.....Company makes available upon request a literature reference describing line of urea peroxide. Included is information on chemical and physical properties, uses and handling. Product Bulletin No. 10.
402G Buffalo Electro-Chem. Co.

Waxes, Polyethylene.....New illustrated 8 p. Brochure describes in detail the typical properties, applications and compatibility characteristics of Eastman's new polyethylene waxes, Epolene "E" and Epolene "N."
402H Eastman Chem. Products.

Wetting Agents.....24 p. booklet covers: current industrial status of wetting agents; Oronite wetting agent (typical analysis, surface & interfacial tension, wetting coefficient, etc.); industrial applications.
402I Oronite Chem. Co.

Zirconium.....Numerous important uses—acid-resistant materials, corrosion-resistant materials, electronic getter, scavenger, etc. Furnishes pertinent technical data on company product line in Bulletin No. 700.
402J Metal Hydrides.

Construction Materials

Alloys.....Announces a new informative Brochure describing "Grac"...a lead-base anti-friction alloy. Included are the proven uses for Grac, an outline of how to use it, its outstanding properties, etc. 4 p.
402K Graphitized Alloys Corp.

Alloys.....Fully illustrated, 100 p. describes Haynes alloys for high-temperature service. Includes information on cobalt-base alloys, nickel-base alloys, iron-base alloys, etc. Request Bulletin No. F-6612C.
402L Haynes Stellite Co.

* See explanation on p. 398

Alloys, Cast.....Presents comprehensive article, "A Selection Guide to Corrosion-Resistant Cast Alloys." Includes data on mechanical, physical & fabricating characteristics of stainless alloys. Illustrated.
403A Alloy Casting Institute.

Alloys, Stainless Steel Brazing.....New fully illustrated catalog describes the chemical and physical properties and numerous typical applications of Nicrobraz stainless steel brazing alloys. Request Form No. SD-21.
403B Wall Colmonoy Corp.

Cements, Insulating.....Eagle-Picher One-Cote cement insulates, protects, finishes in one quick application. Cement is clean, easy to handle—provides a smooth, light-reflectant surface. Request free sample.
42 *Eagle-Picher Co.

Coatings, Protective.....Aluminum paints keep maximum lustre & give lasting protection under severe conditions of moisture, alkali & acid fumes, creep corrosion & hot sunlight. Formulated in 4 types. Request literature.
403C Arco Co.

Coatings, Protective.....Covers 25 types of maintenance paints & coatings. Divided into sections according to job so that reader can quickly find type of paint recommended by manufacturer for a specific purpose. 6 p.
403D Thompson & Co.

Coatings, Protective.....Describes Amercoat No. 87—a heavy bodied, high solids vinyl resin coating which can be applied at thicknesses up to 10 mils in one coat. General, physical & chemical properties detailed.
403E Amercoat Corp.

Coatings, Protective.....“How to Apply Iron Phosphate Coatings to Steel in Preparation for Painting” covers process by which iron phosphate coatings improve paint adherence & prevent corrosion on steel. 12 p.
403F Oakite Products.

Fabrication, Metal.....Booklet, “Facilities & Products,” with information & photographs which show why company can turn out—at low cost—specialized heavy equipment for chemical plants, available upon request.
67 *Newport News Shipbuilding.

Fabrication, Metal.....Manufactures metal products for many industrial uses . . . from complete carbon-black plants to steel conveyor boxes. Designs, engineers and fabricates to specific needs. Full data.
306 *Boardman Co.

Fabrication, Plate.....Company is thoroughly experienced in working and welding numerous alloys and clad materials, as well as the carbon steels and stainless steels. For complete details, request Bulletin PF.
72 *Downingtown Iron Wks.

Fabrication, Process Equipment.....Announces valuable reference, “Custom-Fabricating Tanks & Pressure Vessels,” describing the services available for your biggest & toughest jobs. Catalog No. 554.
119 *Nooter Corp.

Fabrication, Process Equipment.....New, low cost corrosion-resistant equipment . . . made by Haveg from Haveg 1810 polyvinyl chloride. Covers new construction material, sizes, corrosion-resistance data, etc.
84 *Haveg Corp.

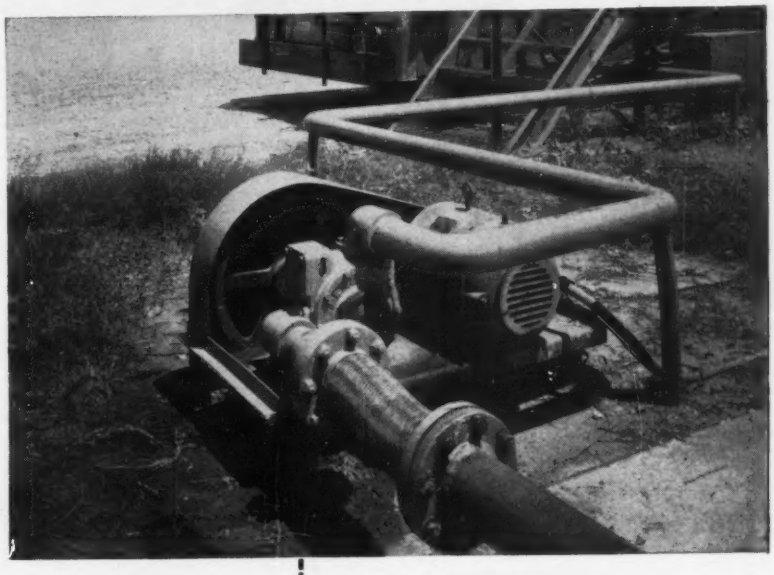
Insulation, Industrial.....No matter where your insulation job may be—Armstrong can give you efficient, well-integrated, on-the-job service from original specs to final installation. Descriptive Booklet.
284 *Armstrong Cork Co.

Insulation, Pipe.....Amosite...the South African asbestos with long, strong, resilient fibers gives Unibestos pipe insulation greater strength and superior insulating ability. Information in Bulletin No. 109C.
82 *Union Asbestos & Rubber Co.

* See explanation on p. 398

FLEXON METAL HOSE *Operating Briefs*

Vibration Stress on Fittings Relieved by Flexon Metal Hose



Pulsating pumps used to pump aviation gasoline were causing vibration that produced undue stress on fittings and lines leading to the pumps. The pumps are installed at an aviation gasoline bulk station where loose and ill fitting connections are a definite hazard.

Installation of 15″ sections of 3″ I.D. bronze Rex-Weld 91 Hose at the connections solved the problem completely. The flexible connections absorb all the vibration to rigid piping and fittings without loosening or undue wear.

If you have connection problems involving vibration, misalignment or expansion, call your Flexonics distributor today. He will supply the *right* Flexon Hose for your application to solve your problems.

FLEXON
The Complete Line for good connections

REX-WELD
corrugated metal hose is available in stainless steel, steel, bronze and alloys; sizes 3/16″ through 24″, I.D.; for burst pressures to 12000 psi.

REX-FLEX
corrugated stainless steel hose; sizes 3/16″ through 6″; working pressures to 3100 psi.

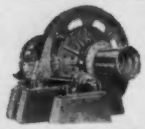
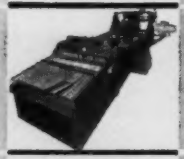
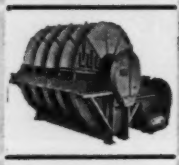
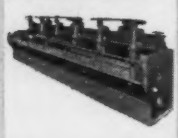
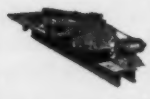
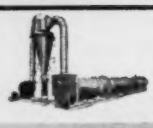
REX-TUBE
interlocked, square locked and ball bearing type hose and tubing in steel, bronze, stainless steel and other alloys; sizes 3/16″ through 12″, I.D. for low and moderate pressures and for use as conduit, ducting, exhaust, protective armor, etc.

CATALOG No. 147
gives basic specifications and application data for Flexon Metal Hose. Write for your copy, today.

Flexonics *Corporation*
CHICAGO METAL HOSE DIVISION
1317 S. THIRD AVENUE • MAYWOOD, ILLINOIS
FORMERLY CHICAGO METAL HOSE CORPORATION
Manufacturers of flexible metal hose and conduit, expansion joints, metallic bellows and assemblies of these components.
In Canada: Flexonics Corporation of Canada, Ltd., Brampton, Ontario

Flexon identifies products of Flexonics Corporation that have served industry for over 53 years.

DENVER PROCESS EQUIPMENT

		SIZES	
DENVER (patented) SUPER AGITATORS and MIXERS		3'x 3' to 20'x 20'	Patented standpipe around propeller shaft assures positive agitation and circulation. Patented wearing plate prevents sand-up or shut-down. Heavy duty as well as acid proof construction is available in both open type, air lift and Super Agitator models. Please write for Bulletin No. A2-B4.
DENVER Steel-Head BALL MILL		3'x 2' to 6'x 12'	A Denver Steel-Head Ball Mill will suit your particular need. Five types of discharge trunnions. All-steel construction. Low initial cost due to quantity production. Quick delivery. Laboratory and pilot plant mills also available. Please write for Bulletin No. B2-B13.
DENVER CLASSIFERS		18" to 60" Wide Suitable Length	Denver Rake Type Classifiers are available in sizes from 1'-6" x 14'-8" to 8' x 21'-8". Denver Spiral Classifiers range in size from 6" x 5'-8" to 60" x 33'-4". Denver Hydro Classifiers are available in diameters from 6' to 55'. All are designed to efficiently separate fine particles in specific applications. Please write for bulletin No. C5C-B.
DENVER Forced-Feed JAW CRUSHER		2¼"x 3½" to 32"x 40"	Cast Steel Frame, manganese jaw and cheek plates. Large diameter shafts reduce shaft deflection and thus increase life of heavy duty, oversize roller bearings in bumper. Setting easily controlled. Please write for Bulletin No. C12-B12.
DENVER Wet Reagent FEEDER		0 cc to 2000 cc	Accurately meters minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Handwheel adjustment to control amount of liquid is simple and accurate. Used in multiples for higher capacities. Please write for Bulletin No. F6-B9.
DENVER Disc FILTER		1 Disc, 2' to 8 Disc, 6'	Special, patented design of segments in Denver Disc Filters use both gravity and vacuum to give a drier filter cake. Drainage is complete and positive, with no blow-back. Simple, low-cost, dependable construction. Quick delivery. Also Drum and Pan Filters. Please write for Bulletin No. F9-B2.
DENVER "Sub-A" FLOTATION		Laboratory and Commercial	Flotation is the selective separation of particles from each other in a liquid pulp by means of air bubbles. More large plants are installing Denver "Sub-A's" for their entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, low-cost, simplified continuous operation. Please write for Bulletin No. F10-B81.
DENVER Wilfley Concentration TABLES		5 to 150 T/24 Hrs.	A mechanically operated, longitudinally reciprocating table consisting of a deck having a plane surface partly riffled and a tilting device. It separates materials into bands and handles the coarsest sands with excellent results. Ideal for separation of groups of particles having a similar range of specific gravities. Write for Bulletin No. T1-B3.
DENVER LABORATORY EQUIPMENT		Batch or Continuous	Batch and continuous test models of Crushers, Screens, Ball Mills, Pulverizers, Rod Mills, Classifiers, Agitators and Mixers, Pulp Distributors, Feeders, Flotation Machines, Pumps, Thickeners, Filters, Dryers, Tables, Samplers. Results obtained on Denver Laboratory Equipment can be duplicated by commercial machines. Please write for Bulletin No. LG3-B10.
DENVER Standard DRYERS		2'x 15' to 5'x 40' and larger	Available in several types: Direct Heat, Indirect Heat, and Steam Tube. Let DECO Engineers solve your drying problem. No dryer problem too small or too large. Please write for Bulletin No. D4-B2.

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LITERATURE . . .

Insulation, Pipe.....Lower heat losses, lower cost with new Snap*On glass fiber pipe insulation. Available in sizes that will fit pipe from ¾" to 33" nominal diameter, inclusive. Request Technical Bulletin SO-55.
273 *Gustin-Bacon Mfg. Co.

Insulation, Pipe & Block.....New universal pipe & block insulation for all temperatures from 100° to 1600°F. Illustrated Folder shows specifications, installation details, and facts on Alltemp insulation.
43 *Philip Carey Mfg. Co.

Platinum, Gold & Silver.....Company announces the availability upon request of a descriptive reference entitled, "Platinum, Gold and Silver for Science, Industry and the Arts." Coded as Folder No. C-20.
312 *American Platinum Wks.

Refractory Grain.....24 p. reference, "Norton Refractory Grain," offers many charts, tables and photographs in color—a wealth of information on nature, performance, and application of refractory grains.
91 *Norton Co.

Steels, Clad.....Releases new, fully-illustrated leaflet, "Hortonclad," describing a composite metal having an integral and continuous bond, produced by a new and revolutionary high vacuum brazing process. 4 p.
404A Chicago Bridge & Iron Co.

Steels, Stainless.....Covers superior stainless steel sheets, strip, bars, plates, wire, forgings, etc. Data in informative 44 p. booklet, "Making the Most of Stainless Steels in the Chemical Processing Industries."
49 *Crucible Steel Co.

Steels, Stainless.....Offers "Special Steels for Industry"—16 p. of data on proper selection & application of principal AL special alloy products; stainless, tool & electrical steels & sintered carbides.
276 *Allegheny Ludlum Steel Corp.

Titanium.....Shows resistance to chloride solutions and retains useful strength up to 800-1000F. Other advantages and data on application and fabrication of titanium alloys in descriptive Rem-Cru Review.
338 *Rem-Cru Titanium.

Electrical & Mechanical

Conductors, Bus.....There's an Alcoa aluminum bus conductor engineered to fit every bus application. For details, request your copy of "Service Records of Alcoa Aluminum Bus Conductor Installations."
58 *Aluminum Co. of America.

Drives.....8 p. illustrated catalog and selection guide describes the new Type VS Class 2 Gyrol Fluid Drive . . . for general purpose industrial applications. Request your copies of Bulletins Nos. 9419 and 9519.
404B American Blower Corp.

Drives, Adjustable-Speed.....Covers general-purpose, full-wave, Thy-mo-trol adjustable-speed drive. Cites in detail the drive's simplicity of operation and economy. Request fully illustrated Bulletin GEA-6234.
404C General Elec. Co.

Drives, Variable Speed.....Describes the Pfaudler PW drive . . . a variable speed drive for agitator speeds from 60 to 340 rpm. For complete information on this versatile new drive, request Bulletin No. 923.
436a *Pfaudler Co.

Fuses.....Describes current-limiting fuses rated 250 & 600 volts in sizes from 6 to 200 amperes. Includes specifications, curves of current-limiting characteristics, etc. Request illustrated Bulletin GEA-6319.
404D General Elec. Co.

* See explanation on p. 398

Fuses.....Describes Great Western ferrule type renewable & non-renewable fuses in a complete range of capacities for industrial purposes . . . glass top plug fuses for commercial & household use. Illustrated Catalog.
405A Titeflex, Inc.

Gaskets.....Spirotallic gaskets hold their seal because they are made of spirally wound interlocking plies of asbestos & spring-like metal strip. Gaskets compress easily with light bolting. Catalog PK-35A.
328 *Johns-Manville.

Gaskets, Teflon.....The ideal seal for many process applications is a Flexitallic gasket with teflon trapped between edges of stainless steel. For complete data request folder, "Teflon in Flexitallic Gaskets."
292 *Flexitallic Gasket Co.

Motors.....Announces new line of general-purpose ball bearing polyphase motors in rerated NEMA frame sizes 182 thru 326. Suitable for indoor or outdoor use. Describes construction features in Bulletin No. MU-202.
154 *Wagner Elec. Corp.,

Motors.....Covers new series of totally-enclosed & explosion-proof motors. Motors (Types J & E) engineered for operation where dangerous fumes, dusts, combustible materials, etc. are prevalent. Bulletin No. 1879.
405B U. S. Elec. Motors.

Motors.....''Motors in Industry'' describes & pictures recent applications of electric drives in such operations as petroleum transfer, catalytic cracking, thermal reforming & chemical treatment. Vol. 2 No. 9.
405C ACEC Elec. Corp.

Motors, Totally-Enclosed.....For dirty or corrosive location or for outdoor operation in all kinds of weather. Available in ratings on frames larger than NEMA 505 up to 3000 horsepower. Data in Bulletin 51B7149.
76 *Allis-Chalmers Mfg. Co.

Motors, Vertical.....Illustrated, 12 p. emphasizes reduced maintenance costs & simplified lubrication of new motor —shielded (dripproof), hollow-shaft, high-thrust type, ranging from 7½ to 500 hp. Bulletin GEA-6280.
405D General Elec. Co.

Packings.....Definite savings in maintenance costs...when you use spiral or die-molded ring packings. Means long uninterrupted sealing service with less wear on rods, shafts, sleeves or stems. File DMCE.
TL319 *Durametallic Corp.

Packings, Ring.....Furnishes complete descriptions of the Chempro lines of teflon ring packings, teflon impregnated asbestos packings, V-type packings and the patented teflon seal cage. Bulletin No. CP552.
405E Chemical & Power Products.

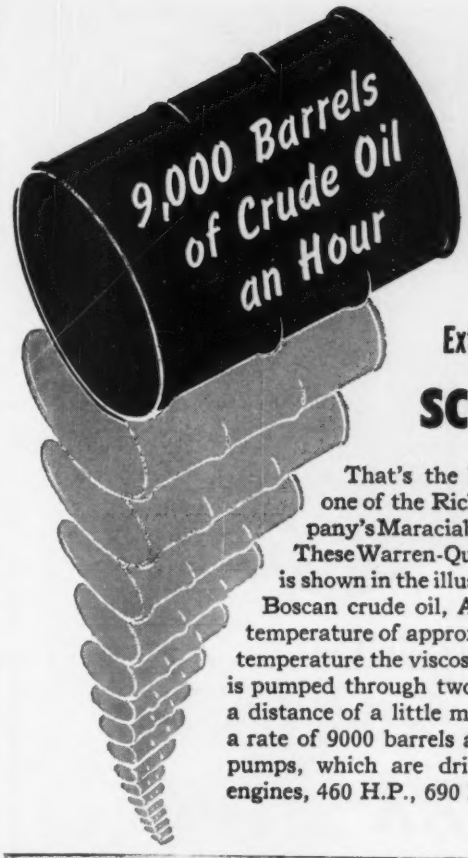
Reduction Units, Speed.....New 100 series Ratiomotors are standard stock motorized gear reduction units of simplified combination construction which offer maintenance savings & adaptability. "100 Series Ratiomotors."
405F Boston Gear Wks.

Saddles, Intalox.....16 p. reference offers full technical data and specifications on Intalox Saddles, including comparative charts showing relative pressure drops, flooding limits, gas pumping costs, etc.
102 *U. S. Stoneware Co.

Seals, Mechanical.....Combining chemically impervious teflon with a balanced bellows design—Chemiseal external mechanical seals last longer & give unsurpassed performance. Details in Bulletin No. MS-954.
315 *U. S. Gasket Co.

Tanks, Pumpless Rectifier.....G-E pumpless rectifiers are the most economical way to get d-c power in the 750-kw range and above. Company makes available complete product information in Bulletin No. GEA-5689.
62-3 *General Elec. Co.

*See explanation on p. 398



USING 3
WARREN-QUIMBY
External Gear and Bearing
SCREW PUMPS

That's the hourly loading record at one of the Richmond Exploration Company's Maraciabo operations in Venezuela. These Warren-Quimby Pumps, one of which is shown in the illustration, are used to pump Boscan crude oil, A.P.I. Gravity 10.5°, at a temperature of approximately 160°F., at which temperature the viscosity is 6000 S. S. U. The oil is pumped through two 18″ submarine pipelines a distance of a little more than one mile and at a rate of 9000 barrels an hour, using three such pumps, which are driven by Nordberg diesel engines, 460 H.P., 690 R.P.M.

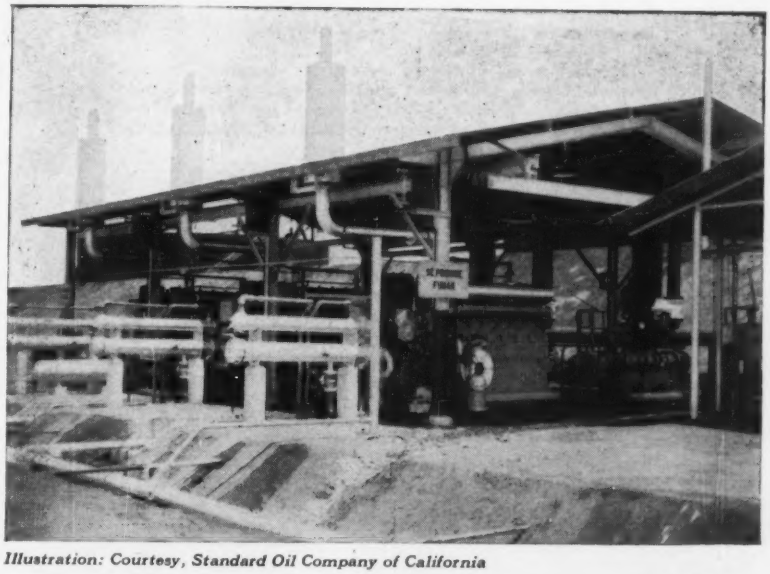


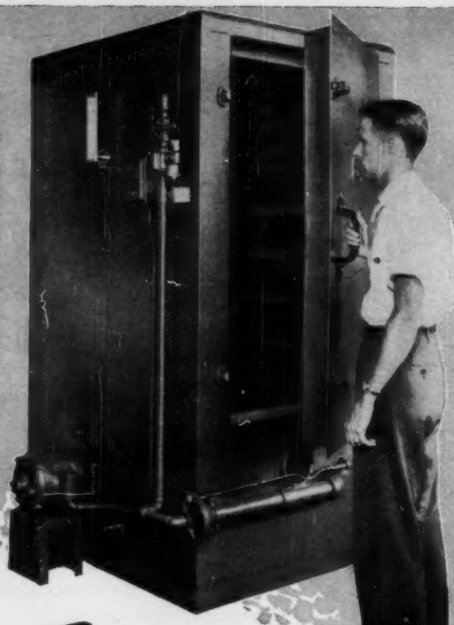
Illustration: Courtesy, Standard Oil Company of California

Whatever your pumping problem . . .
it will pay you to specify:

WARREN QUIMBY PUMPS

PQ-7

WARREN PUMPS
WARREN STEAM PUMP COMPANY, INC.
Warren, Massachusetts



Lower portion of this gas fired oven completely contains blower and heater . . . in space that might otherwise be wasted. Horizontal recirculation of the heated air insures even heat, efficient operation.

Compact, Efficient... Automatically Controlled Ovens

BY KIRK AND BLUM

Your oven needs . . . large or small batch or continuous production for drying, baking or dehydrating . . . can be filled by KIRK & BLUM.

The small ovens illustrated are shipped completely assembled, thoroughly tested and ready to operate. Installation is a one-two process: Spot in place . . . make connections for Gas, Steam or Electric Ovens . . . and you're ready for production.

Write for booklet, "The Industrial Ovens,"

THE KIRK & BLUM MANUFACTURING CO
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Electric laboratory type oven used by noted resistor manufacturer in making TV set components. Uniform drying heat is provided by recirculation of air provided by blower and heaters enclosed in base.

LITERATURE . . .

Teflon Products.....Illustrated booklet, "The Best in Teflon," covers data on teflon parts & products—bellows, bellows connectors, pump & valve packings, tubing & other molded forms. 12 p. Chemlon Catalog.
307a *Crane Packing Co.

Turbines, Steam.....Turbines range from 150 horsepower down to fractional in 6 frame sizes. Feature large number of manually operated valves for individual control of steam nozzles. Details in Bulletin 135.
75 *Coppus Engrg. Corp.

Handling & Packaging

Belts, Conveyor, Woven Wire.....Presents a 130 p. Reference Manual illustrating and describing company's woven wire conveyor belts. Includes mesh specifications, design information, and metallurgical data.
324 *Cambridge Wire Cloth Co.

Cans, Seamless Metal.....Widely used by industry, laboratories & the medical trade for packaging, storing & handling parts & products. Available in 1/16 oz. to 16 oz. capacities. Data in illustrated Bulletin 116.
406A George D. Ellis & Sons.

Containers, Metal.....Illustrates & describes company's wide range of sizes & styles of metal containers that make it easier, less expensive, more convenient & reliable to package industrial products. Bulletin 57A.
406B George D. Ellis & Sons.

Conveyor-Elevator Systems.....For bulk handling problems where corrosion, degradation, dust or economical adaptation to limited space or plant layout are vital considerations. Information in Bulletin No. 349.
280 *Stephens-Adamson Mfg. Co.

Conveyors.....Describes the Model 600R "Handy-Handler" . . . a greater capacity lightweight conveyor for handling bulk materials. Includes data on the features and specifications. Request illustrated Form 54510.
406C Belt Corp.

Conveyors.....Illustrated, 40 p. covers four featured, patented products and custom built conveyor equipment. Includes: Magnavator; Tube-Veyor; Chip-A-Way; Welded Tube; etc. Request your copy of Catalog No. 400.
406D Prab Conveyors.

Cyanide Handling.....''Handling and Feeding of Aero Brand Cyanide'' includes sections on: chemical and physical properties; transportation; unloading and storage of drums; general notes on feeding cyanides; etc.
406E American Cyanamid Co.

Drums, Magnetic.....Eriez magnetic drum is an unbeatable unit for extracting tramp iron from materials conveyed in spouts, chutes, spiral conveyors, etc. Find complete information on drum in Bulletin B-601.
71a *Eriez Mfg. Co.

Elevators, Manlift.....Company makes available an illustrated folder describing the four standard models of Humphrey Manlift Elevators. Includes data on operating and safety features. Request Folder No. HF-55.
406F Humphrey Elevator Co.

Feeders, Belt Gravimetric.....For continuously feeding dry materials at medium to high rates. Tells how feeder with Sens-A-Gram controller maintains accuracies well within +1%. Bulletins Nos 37-M1 and AR-8.
406G Omega Mach. Co.

Feeders, Volumetric.....Volumetric feeders of simple design and rugged construction, easily adapted to installations requiring proportional pacing by auxiliary meters. Describes feeders in Bulletin 45-H8.
331 *Omega Mach. Co.

* See explanation on p. 398

Feeders, Wet Reagent.....Accurately meter minute quantities of liquid from 0 cc to 2000 cc per minute. Float valve in tank permits connection of feeder to bulk storage device. Data in Bulletin F6-B9.
404e *Denver Equipment Co.

Liquids Handling Equipment.....Describes Ellisco's complete line . . . for petroleum, chemical, mine, railroad & construction industries. Heavy duty measures, funnels, delivery cans, etc., illustrated. Bulletin 63.
407A George D. Ellis & Sons.

Magnets.....Describes the line of electric and non-electric magnets for installation in, on or above material conveying systems and integration with processing machinery. Full details in Catalog C-5000-B.
50 *Dings Magnetic Separator

Magnets....."Magnetic Ideas From Eriez" contains case histories explaining how various firms use permanent, non-electric magnets to prevent iron contamination in their products. 24 p. Brochure B-213.
407B Eriez Mfg. Co.

Materials Handling.....When time is important in handling dry materials in bulk . . . rely on Fuller systems (Fuller-Kinyon, Airveyor, Airslide, Fuller-Fluxo). Data in "How To Pull Dollars Out of Thin Air."
48 *Fuller Co.

Pulleys, Magnetic.....Rugged construction & powerful magnetic strength give trouble-free operation & efficient protection against tramp iron damage to costly crushers, grinders, stokers, etc. Bulletin 501.
71c *Eriez Mfg. Co.

Separators, Magnetic.....Emerson magnetic separator utilizes powerful, permanent magnets ingeniously arranged for high efficiency—has no moving parts—requires no extra power—is easily cleaned—etc. Full data.
407C Emerson Mfg. Co.

Tractor-Shovels.....The Michigan 175A handles bigger jobs . . . cheaper. Announces the availability of a 12 p. Tractor-Shovel booklet containing explanation and cutaway drawings of the Michigan power train.
53 *Clark Equipment Co.

Trucks, Pallet.....Describes hand hydraulic pallet truck (Model EX) . . . for single or double faced pallets. 2500 pounds up to 6000 pounds capacity. For complete product information, request Catalog No. 535.
407D Barret-Cravens Co.

Heating & Cooling

Boilers, Packaged.....Describes the new forced-draft "CB"—with the fan mounted inside the front hinged door. Latest Boiler Bulletin covers your size requirements—contains specification data to help you plan.
261 *Cleaver-Brooks Co.

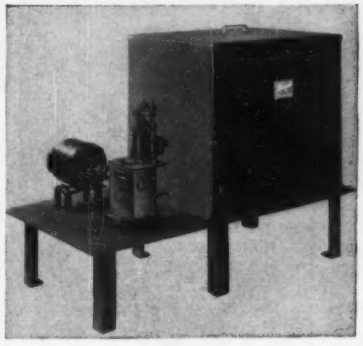
Coolers, Cascade.....Describes & illustrates new impervious graphite cascade cooler which provides economical high temperature processing. Includes typical properties of "Graph-I-Tite." Bulletin No. GS 101.
407E Graphic Specialties Corp.

Coolers, Cascade.....Designed for cooling corrosive liquids and gases. Low initial cost and maintenance, radiused returns for low pressure drop as well as redwood waterguide strips. Request Catalog No. S-6820.
227e *National Carbon Co.

Dehumidification Equipment.....Presents a new illustrated bulletin showing refrigeration as well as adsorption type dehumidification equipment for dehumidification of compressed air & gases. Bulletin No. R-11.
407F Desomatic Products.

* See explanation on p. 398

MANZEL WILL FIND THE ANSWER TO ANY CHEMICAL FEEDING PROBLEM



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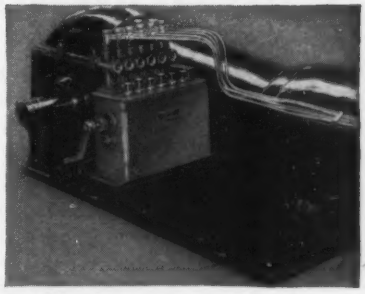

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Developed for diversified applications in the chemical processing, food processing, plating and metal working industries, COROCRETE is quickly and easily applied over existing concrete surfaces . . . handles like cement topping. Thicknesses from ¼-inch minimum to ⅜-inch maximum (per layer) are recommended for best results.

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LITERATURE . . .

Generators, Steam.....12 p. describes formulas behind all package steam generators, & shows how installation of generator can raise steam capacity in an existing boiler room without extensive structural changes.
408A U. S. Radiator Corp.

Heat Exchangers . . . . . Describes how equipment offers: chemical resistance to practically all corrosive fluids; resistance to severe thermal shock; high heat-transfer rates; low maintenance; etc. Catalog S-6740.
227c *National Carbon Co.

Heat Exchangers.....Brown Fintube's design eliminates baffles, minimizing pressure drop. Booklet lists dimensions & capacities of standard sizes. Other sizes & designs to meet any requirement. Bulletin 521.
241 *Brown Fintube Co.

Heat Exchangers.....Describes new Type "SSF" stainless steel heat exchangers for heating or cooling liquids & gases used in chemical, pharmaceutical, refining & allied processing industries. Catalog No. 1155.
408B Young Radiator Co.

Heat Exchangers.....Designers & builders of bends, coils, condensers, coolers, heat exchangers, heaters, piping, reboilers, etc., offer reference to help select your heat transfer equipment. Bulletin No. 250.
302 *Whitlock Mfg. Co.

Heat Exchangers.....Covers complete line of Karbate brand impervious graphite shell & tube heat exchangers. Engineered for maximum corrosion resistance & minimum maintenance. Request Catalog Section S-6800.
252-3 *National Carbon Co.

Heat Transfer Equipment.....Provides heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries. Bulletin describes the wide range of equipment.
162 *Henry Vogt Mach. Co.

Heat Transfer Equipment.....Versatile & efficient dryer-cooler does four big jobs—crystallizes . . . dries . . . anneals . . . cools. Describes Allis-Chalmers heat transfer equipment in Bulletin No. 07B6368.
223 *Allis-Chalmers Mfg. Co.

Heaters, Electric Screen.....Reduce costs....Increase production with Hanco heaters. Describes advantages: faster screening — faster screen changes; 5-way cost reduction; fast, easy installation; etc. Bulletin 521.
408C F. R. Mannon & Sons.

Heaters, Unit.....Grid unit heaters feature trouble-free heating service in the major chemical plants for over 25 years—no maintenance or repairs. Get the full story in booklet, "Corrosion in Unit Heaters."
86 *D. J. Murray Mfg. Co.

Heating Systems, Dowtherm.....Furnishes descriptive information on Dowtherm heating systems for processes requiring precision control of high constant temperatures at low pressures, in Bulletin ID-54-5.
133 *Foster Wheeler Corp.

Heating Systems, Hot Water.....Covers new packaged Iso-Therm hot water heating system designed to solve problem of how to get a maximum amount of hot water for peak loads with a limited size boiler. Bul. 920A.
408D Fred H. Schaub Engrg. Co.

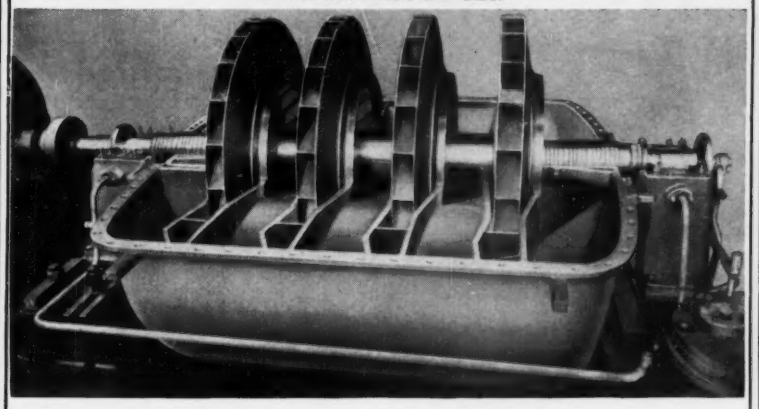
Heating Tapes.....Electrothermal heating tapes are safe—economical—efficient surface heaters . . . for use wherever heat is required in the laboratory and in production. Details in 6 p. illustrated Bulletin.
408E Arthur S. LaPine & Co.

Platecoils.....Designed for tank heating and cooling problems due to inefficient pipe coils. These cost-saving platecoil heat or cool 50% faster and take 50% less space in the tank. Offers Bulletin No. P61.
30 *Tranter Mfg.

* See explanation on p. 398

ALL WELDED BLOWER

of corrosion-resistant steel



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KILL IT *with a*
DOW CORNING SILICONE DEFOAMER

Use the space now wasted on foam to increase your output by as much as 100%. For example:

- **production of vacuum concentrated food product increased by 60%**
- **refinery still through-put increased from 1500 to 2500 barrels per day**
- **yield of textile vat dyes increased by 100%**

And you get increased production immediately without installing expensive new equipment. All you have to do in the case of most foamers is add a few parts per million of the water dilutable Antifoam AF Emulsion or, where solvents can be tolerated, a dispersion of Antifoam A. Both of these Dow Corning silicone defoamers are physiologically harmless. Both of them **increase production • reduce processing time • eliminate the waste and fire hazard of boil-overs.**

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Please send me data and free sample of
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or ☐ Dow Corning Antifoam AF Emulsion

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DO YOU NEED PRECISION FILTERS?

The smooth, tough surface of electro-deposited ***LEKTROMESH*** • • the great uniformity of hole size — the wide range of commercial "mesh" sizes from 25 to 400 per inch—plus the fact that it can be stamped, cut, and even scraped without distortion of its mesh, all make

LEKTROMESH

ideal for precision filtration when you need pure nickel, pure copper, or a combination of copper-nickel.

Write Department 15

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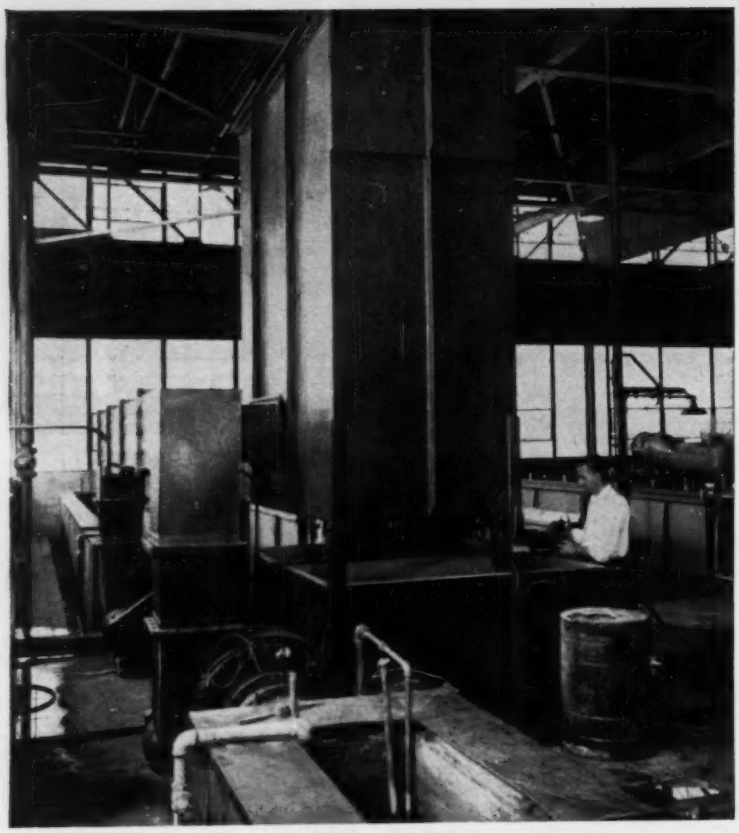
THE C. O. JELLIFF MANUFACTURING CORPORATION SOUTHPORT, CONN.

WIRE PRODUCTS SINCE 1880



Steel Pickling Installation

KNIGHT FUME WASHERS

Knight Fume Washers are wet contact scrubbers. The working surface is BERL Saddle packing. This unique shape not only provides maximum surface area and minimum pressure drop, but also causes the repeated directional changes in the gas stream necessary for efficient scrubbing. Where greater turbulence is desired, a bed of graded sizes of BERL Saddles is employed.

Each unit is designed to provide low-cost operation,, minimum fan power and water consumption. Careful attention is given the liquid distribution system, since it is so important to efficient operation. Each unit is equipped with a mist eliminator section through which the washed gas is discharged.

Knight Fume Washers are fully protected against corrosion by application of Pyroflex, Sealon, or Neoprene lining to the full-welded steel shell. When required, an acid-proof brick lining is installed over the membrane. All internal parts such as the grillage, BERL Saddle packing and distributor are made of acid-proof material. Thus, the entire unit is inert to chemicals being handled. Typical fume removal installations:

HCl and organic vapors	Chlorine gas
H_2SO_4 pickling fumes	Smelter dust, fly ash
SO_2 and SO_3 gases	Plating tank exhaust
Nitric Oxides and HF	

Write for Bulletin No. 9B on Fume Washers.

Maurice A. Knight 108 Kelly Ave., Akron 6, Ohio

Acid and Alkali-proof Chemical Equipment

LITERATURE . . .

Towers, Cooling.....Extra long gear and bearing life of Fluor-Western speed reducers is an important factor in overwhelming preference for Fluor cooling towers. Offers bulletin, "Cooling Water for Industry."
362a *Fluor Corp.

Towers, Cooling.....New 20 p. booklet, "Test Your Tower," describes simple direct method by which purchaser of industrial cooling tower can assure himself that he will receive performance exactly as specified.
9 *Marley Co.

Traps, Steam.....Company's product line features long trap life with infrequent maintenance. Makes available on request a 44 p. Steam Trap Book with practical information designed to give you better trapping.
268 *Armstrong Mach. Wks.

Traps, Steam.....Larger valve orifice saves four ways: initial cost; upkeep expense; warm-up time; production time. Six types for every process, heat, power use. Complete information in Trap Catalog 953.
83 *W. H. Nicholson & Co.

Tubes, Condenser.....Announces availability of 156 p. Bridgeport Condenser Tube Handbook containing helpful data on condenser tube alloys, Duplex tubes, corrosion of all types & numerous other subjects.
96 *Bridgeport Brass Co.

Instruments & Controls

Analyzer-Recorders, Oxygen-Combustibles.....Provide a continuous two-in-one check of combustion efficiency by recording both oxygen & combustibles in flue gas. Product Specifications Nos. E65-1 & E12-5.
74 *Bailey Meter Co.

Controllers, Thermostatic Pilot.....Describes new Fultrol Thermostatic Pilot Controller No. 1100. Provides accurate control of liquids or air temperature when used in conjunction with valves, dampers, etc.
78-9a *Fulton Sylphon Div.

Gages & Valves, Liquid Level.....Covers complete product line of armored gages and valves . . . for handling hazardous or valuable liquids without fear of leakage or breakage. Request detailed General Catalog.
L325 *Jerguson Gage & Valve Co.

Instrumentation.....Versatile ElectroniK instruments increase speed, accuracy of cooling tower research. For complete reference data, request reprint of article—Third Quarter Issue, "Instrumentation."
160-1 *Minneapolis-Honeywell.

Meters.....Fully describes company's new line of all-ferrous Rotocycle meters . . . designed for metering low pressure liquid fertilizers such as aqueous ammonia and ammonium phosphate. Bulletin No. O.G. 408.
410A Rockwell Mfg. Co.

Meters.....Illustrated, 12 p. describes line of Propelofio Meters—direct-reading, propeller type instruments for metering water & other liquids. Complete data on features & specifications. Bulletin No. 380-K4A.
410B Builders-Providence.

Meters, Flow.....Feature simple design with only three moving parts—no breakdown due to complicated gears and mechanism. Indicate flow within 3% absolute accuracy, even with pulsating flow. Detailed Bulletin.
TL321 *Henszey Co.

Meters, Flow, Open Channel.....Measurement of flow of liquids with suspended solids for water supply and waste treatment applications in chemical process plants is discussed in 12 p. illustrated Bulletin M22-5.
410C Bailey Meter Co.

* See explanation on p. 398

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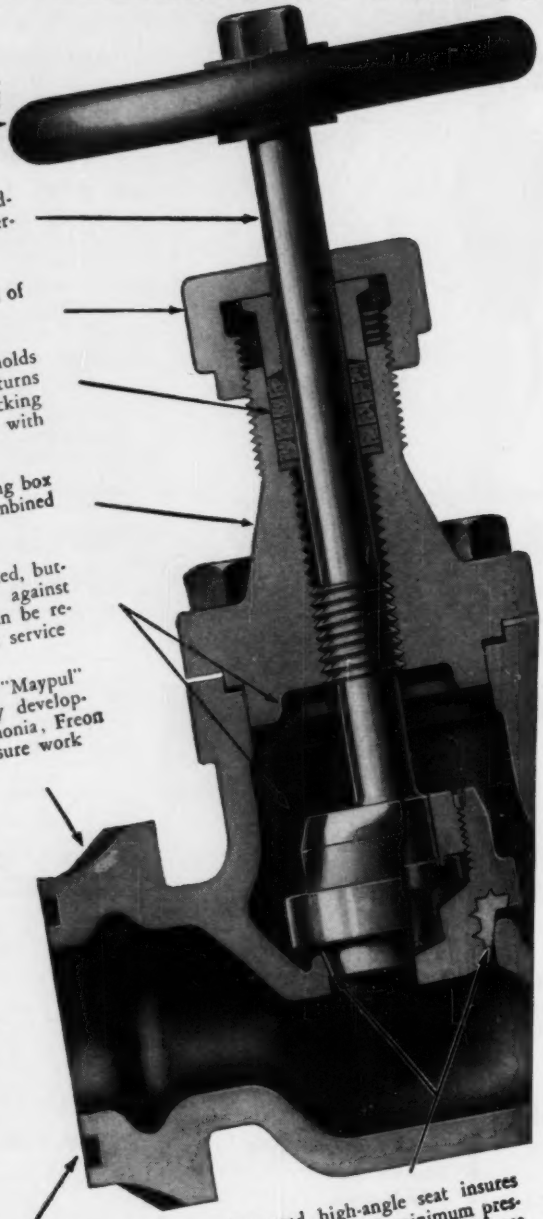

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Ample packing holds pressure while stem turns freely. Special packing supplied for use with Freon refrigerants

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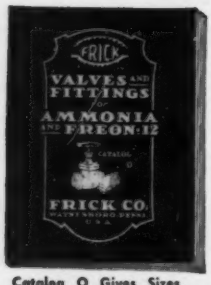

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Patented high-angle seat insures tight closure with minimum pressure. Scale is pushed off the seat as valve enters

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LITERATURE . . .

Meters, Mercury Vapor.....New illustrated Folder is available describing line of mercury vapor meters for detecting toxic concentrations of mercury vapor in plant and laboratory atmospheres. Includes features and operation.
412A Harold Kruger Instruments.

Meters, pH.....Describes Photovolt line-operated electronic pH meter Model 110—a dependable, electronic instrument of high accuracy for universal application in laboratory & factory. Request Bulletin 105.
412B Photovolt Corp.

Potentiometers.....Issues a new reference describing the Wheelco Portable Potentiometer...a highly accurate precision instrument. Includes information on the many valuable features. Illustrated Bulletin F-5760-1.
412C Barber-Colman Co.

Recorders, Temperature.....Newly designed Model "1000" Auto-Lite recorder gives permanent proof of temperature behavior. Request valuable catalog describing the many styles of recorders and indicators.
TR325 *Electric Auto-Lite Co.

Regulators.....Describes Stabiline automatic voltage regulators (Type IE instantaneous electronic—Type EM electro mechanical) for increased efficiency, peak performance & lower costs. Bulletin No. S-351.
412D Superior Elec. Co.

Regulators, Temperature.....Describes No. 999 Temperature Regulator—for accurate control of industrial process temperatures, storage water heaters, bottle washers, slashers, etc. Sizes ¼" to 4" inclusive.
78-9b *Fulton Sylphon Div.

Spectrometers, Mass.....For fundamental petroleum and petrochemical research, for process development and for control, investigate the 21-103C. Complete and detailed information in Brochure No. CEC 1800C-X15.
317 *Consolidated Engrg. Corp.

Thermometers.....Sturdy all-metal construction resists breakage, makes for far longer life on operating equipment. Exclusive multiple helix assures dependable accuracy during long life. Descriptive Bulletin.
336 *Weston Elecl. Instrument.

Thermometers.....Whether you need industrial glass thermometers, dial types, or recorders, the complete American line provides for practically every application. Request descriptive catalog for complete details.
330 *Manning, Maxwell & Moore.

Transmitters, d/p Cell.....Pioneered by Foxboro seven years ago . . . the d/p Cell Transmitter established a new standard of performance in flow measurement and control. Describes design features in Bulletin 13-11.
44-5 *Foxboro Co.

Transmitters, Pneumatic.....36 p. reference covers transmitters for measuring flow, pressure, level or density. Describes & illustrates 22 different models, gives hook-ups, ranges, performance data. Data Book 1004.
100 *Republic Flow Meters Co.

Tubes, Dall Flow.....Reduce meter head loss where it counts . . . at the pipe line. Feature compactness and economy. For complete information on the numerous advantages, request illustrated Bulletin No. 115-L1.
137 *Builders-Providence.

Pipe, Fittings, Valves

Couplings, Elbow.....Makes available literature describing a non-ferrous elbow coupling for faster, more efficient unloading of tank cars containing petroleum products or liquid chemicals. Bulletin No. 70.
412E Atlantic Metal Hose Co.

* See explanation on p. 398

Couplings, Quick-Seal.....In an unlimited range of sizes to handle any material that will flow thru a line—for any application that demands leak-proof connections & long service life. Data in illustrated, 16 p.
413A Titeflex, Inc.

Elbows, Reducing.....Offer important advantages in both piping design & piping cost. Need only 2 welds instead of the 3 required by a standard elbow & a reducer. For full details, request Catalog No. 54.
343 *Midwest Piping Co.

Fittings.....Offers Klinger Master Catalog describing the complete range of products . . . compressed asbestos sheet packings for all purposes, valves, cocks, level gages, synthetic and silicone rubbers, etc.
237a *Klinger Corp. of America.

Fittings, Forged Steel.....Wherever strong, tough pipe joints are needed . . . Watson Stillman forged steel fittings provide a safety factor against costly piping failures. Details in Bulletin No. A3-50.
285a *Watson-Stillman Fittings.

Fittings, Stainless Steel.....New stainless steel fittings will assure you of long, trouble-free service in tough piping applications . . . will reduce down-time and cut maintenance costs. Bulletin No. S-3-55.
285b *Watson-Stillman Fittings

Hose, Metal, Flexible.....Ideal for difficult fluid and gas handling jobs. Durable and leak-proof for conveying, controlling movement and vibration, correcting misalignments, etc. Full details in Bulletin No. 20D.
26 *Atlantic Metal Hose Co.

Joints, Ball, Swing & Strut.....New interesting reference shows petrochemical and petroleum industry applications for Barco ball, swing and strut joints. Illustrated Bulletin No. 28, available on request.
300 *Barco Mfg. Co.

Joints & Couplings.....Teflon expansion joints and flexible couplings absorb shock, vibration, thermal expansion and contraction. Connect unlike piping ends and nozzles. Covers complete data in Bulletin FC-952.
299 *U. S. Gasket Co.

Joints, Swivel.....Loading & unloading line made up with dependable ball-bearing swivel joints provide a wide margin of safety by using the same materials used throughout the pipe lines. Complete Catalog.
265 *Chiksan Co.

Nozzles.....Describes company's line of nozzles for: oil atomizing; humidifying; air washing; desuperheating; spray ponds; milk powdering; acid chambers; concrete curing; etc. Request Catalogs 6-A and 6-C.
R323 *Monarch Mfg. Wks.

Nozzles, Spray.....Company makes available on request a completely detailed Catalog which provides valuable data on Spraco Nozzle line. Includes information on full cone, flat spray & hollow cone types.
BL319 *Spray Engrg. Co.

Pipe & Fittings . . . . . For corrosion-resistant piping. Impervious graphite pipe & fittings readily installed, long lasting, easily maintained, unaffected by most corrosive fluids. Request Catalog No. S-7000.
227b *National Carbon Co.

Pipe & Fittings, Glass.....Company announces the availability of their Pyrex Pipe Catalog describing product line of pipe and fittings, including spacers, adjustable joints, traps and adapter connections.
361a *Corning Glass Wks.

Pipe, Hard Rubber.....Heat-resistant nitrile hard rubber pipe handles inorganics at 250-275 deg. F.—also resists wide range of organic chemicals at room temperature. Details contained in Bulletin No. 96-A.
390c *American Hard Rubber Co.

* See explanation on p. 398

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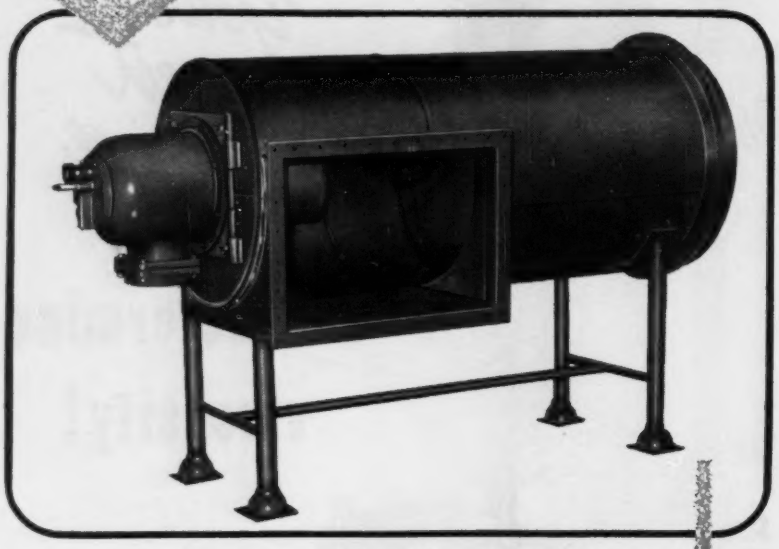

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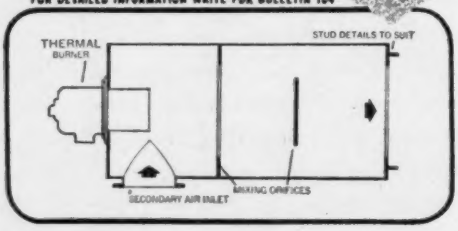
FOR DETAILED INFORMATION WRITE FOR BULLETIN 104



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LITERATURE . . .

Pipe Installation, Glass.....Makes available fully illustrated literature describing the simple procedures involved in laying out and plumbing Pyrex brand glass pipe. Request copy of "Installation Manual."
361b *Corning Glass Wks.

Pipe, Plastic.....General-purpose moderately priced rubber-plastic pipe handles most common chemicals to 170°F . . . except few strong acids & organic solvents. Tough, odorless, tasteless. Bulletin No. 80.
391 *American Hard Rubber Co.

Tubing, Stainless Steel.....Furnishes engineering information on construction and types of flexible stainless steel tubing. Also includes data on fittings. Request this completely illustrated Bulletin No. STC-1.
283 *American Brass Co.

Unions, Forged Steel.....Describes line of new forged steel unions. Presents complete dimensions of unions in sizes ⅛" to 2" in 3000 lb. class. Also covers outstanding design features. Illustrated Bulletin U-1.
285c *Watson-Stillman Fittings.

Valves.....Shear-Seal valves have longer life & are maintenance free because: as Shear-Seal & rotor slide back & forth on each other with use, they keep lapping themselves & seal even tighter. 12 p. comic strip.
414A Barksdale Valves.

Valves.....Line of steel valves feature dependable operation and low maintenance cost. Gate, globe and check types handle the most severe high-pressure, high temperature services. Full details in Catalog 20.
282 *Chapman Valve Mfg. Co.

Valves, Bellows Motor.....Valuable data on the new Bellows Motor Valve—No. 992-D Series for final control element in pneumatic or hydraulic control systems to regulate flow of gas, oil, water or other liquids.
78-9c *Fulton Sylphon Div.

Valves, Diaphragm.....Trouble-free plastic diaphragm valves—choice of general-purpose Ace-Ite, Ace Parian (polyethylene) or Ace Saran. Handles most corrosive chemicals & food ingredients. Bulletin 351.
390a *American Hard Rubber Co.

Valves, Diaphragm, Packless.....Eliminate stem leakage and maintenance on air, vacuum, gas, light oil and similar services. Available in wide selection of materials and sizes. Request Folder No. AD-1942.
293 *Crane Co.

Valves, Drain.....Offers descriptive information on line of Strahman ram type valves . . . the only drain valves that cannot clog up. Made in any cast metal to meet your requirements. Request complete Catalog.
BL323 *Strahman Valves.

Valves & Fittings.....Descriptive reference, "Valves and Fittings for Ammonia and Freon-12," provides sizes, symbol numbers, dimensions and weights of valves, fittings and accessories. Request Catalog "O".
412 *Frick Co.

Valves, Gate.....Darling gate valves are made in metals, types and sizes for most services . . . and for pressures up to 1500 pounds. Feature fully revolving double disc parallel seat principle. Bulletin No. 5003.
320 *Darling Valve & Mfg. Co.

Valves, Plug.....Company's line of non-lubricated steel plug valves features dependable performance at a wide range of temperatures and pressures. For complete details, request informative Wedgeplug Catalog 54-1-W.
353 *Wedgeplug Valve Co.

Valves, Porcelain.....Company makes available detailed literature covering the features and advantages of porcelain valves. Bulletin includes complete description, characteristics and specifications.
271 *Lapp Insulator Co.

* See explanation on p. 398

Valves, Solder & Socket-End.....For faster, trouble-free installation and lasting economy. New Bulletin lists all Jenkins solder end and socket-end valves and gives instructions for soldering and brazing.
279 *Jenkins Bros.

Valves, Solenoid.....Covers entire range of valves...for safe, dependable flow control of liquids, gases, air & refrigerants. Data on proper selection, features, coil construction, etc. Section C-Form RS141.
415A A-P Controls Corp.

Valves, Solenoid.....For low pressure service—air, gas, propane, butane, water, gasoline, light fuel oil & other fluids to 180°F. Covers features, application, operation, dimensions, etc. Bulletin No. 743.
415B Automatic Switch Co.

Valves, Solenoid.....New Type K solenoid valves feature all stainless steel construction of parts in contact with media. Velvetrol cushioned closing eliminates damaging shock & prolongs life. Details in Bulletin K.
415C J. D. Gould Co.

Valves, Tubing.....Covers high quality, low cost valve for tubing—the new Tube-Line Valve. You can cut it into lines in a jiffy . . . requires no threading, no beveling, no pipe-wrench. Bulletin No. 255.
350 *Autoclave Engrs.

Process Equipment

Absorbers.....For absorption of hydrogen chloride and other gases. Produce as much as 20 tons per day 22° Baume acid. Pneumatic automatic control. Complete information offered in Catalog No. S-7460.
227f *National Carbon Co.

Blenders, Twin Shell.....More thorough blending in fraction of the time previously taken. One blender replaces methods which required a separate drum for every mix. Offers descriptive Catalog No. 12.
105 *Patterson-Kelley Co.

Crushers, Jaw.....Illustrated, 24 p. booklet offers complete information on company's line of jaw crushers. Built in eight sizes with capacities up to 300 tons per hour. Details available in Bulletin No. 1124.
16a *Traylor Engrg. & Mfg. Co.

Dealkalizers.....New dealkalizers utilize the ion exchange principle of salt splitting as an effective means of reducing alkalinity in boiler feed and process water. Complete details in Publication No. 4567.
415D Cochrane Corp.

Dehydrators.....Selas Dehydrator continuously dries compressed air, carbon monoxide, carbon dioxide, hydrogen, oxygen, gaseous hydrocarbons and inert gases. Contains full information in Bulletin No. SC-1013.
52a *Selas Corp. of America.

Demineralizers.....High purity results, compact design & low operating costs makes marine demineralizers ideal method for treating boiler feed water on board naval working vessels, barges, etc. Tech. Bulletin Sheet 015.
415E Penfield Mfg. Co.

Dryers.....Available in several types: direct heat, indirect heat, and steam tube. Let Deco engineers help solve your drying problem—no dryer problem too small or too large. Details in Bulletin No. D4-B2.
404j *Denver Equipment Co.

Dryers.....Help solve problems of drying air or other gases. Offer valuable advantages: simplicity of operation & maintenance; low installation cost & minimum maintenance expense. Details in Bulletin D-29.
239 *C. M. Kemp Mfg. Co.

* See explanation on p. 398

Directors' Meeting ...THE MORNING AFTER

In the middle of the night fire hit this plant with sudden, blasting fury. Started in oil storage and spread like lightning. Next morning the directors could rightfully ask, "*Where was our fire protection?*"

Unfortunately, it lay in a desk drawer—a proposal for a fire extinguishing system that would have made oil storage and half a dozen other equally bad hazards fire-safe. Procrastination pigeonholed protection . . . and disaster didn't wait!

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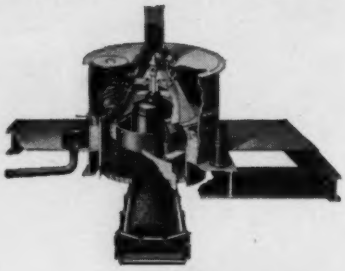

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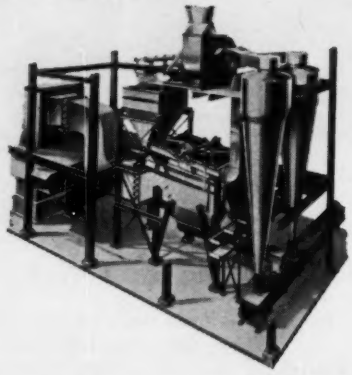

. . . THERMAL
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LITERATURE . . .

Dryers.....Lectro-dryers can dry air & gases in volume to dewpoints below —100°F—can drop relative humidity lower than 10%. Booklet describes machines & how various industries use them to gain efficiency.
264 *Pittsburgh Lectrodryer Corp.

Dryers, Rotary . . . . . The Davenport rotary hot air dryer is of stainless steel construction. Dryer is installed in one of the large processing plants, drying wheat gluten. For complete details, request Catalog A.
BL321a *Davenport Mach. & Foundry.

Dryers, Rotary Vacuum.....Company announces the availability of literature on their vacuum drying equipment (Catalog No. 720) and a new reference covering Stokes Laboratory facilities (Bulletin No. 640).
155 *F. J. Stokes Mach. Co.

Dryers, Spray.....Announces the availability of a fully illustrated reference describing company's line of spray dryers...with horizontal air suspension. Complete details of features and construction. 4 p.
416A Henszey Co.

Drying Systems, Flash.....Systems offer means for handling materials in which drying is combined with pulverizing, or with mild disintegration, or followed by cooling & conveying product to storage. Catalog 54-A.
294 *Raymond Div.

Dust Collectors.....Coupled with unique spiralectrode feature is Buell's Continuous Cycle Rapping—the most effective mechanism yet developed for dry dust precipitation. Illustrated literature available.
150 *Buell Engrg. Co.

Dust Collectors.....In almost every type of industry . . . users have found high efficiency, simplicity & economy of Dustube collectors a difficult combination to equal for top performance. Details in Bulletin 372.
354 *American Wheelabrator.

Dust Collectors.....Series 12 Aeroturn line provides 99.9%+ air-cleaning efficiency. Completely illustrated, 16 p. includes sections on: how it works; construction & assembly; features; installations; etc.
BL372 *Turner & Haws Engrg. Co.

Dust Collectors.....The Type N Roto-Clone is a high efficiency, wet-type dust collector made in 15 sizes with capacity ratings from 750 to 50,000 cfm. Details of valuable features in 24 p. illustrated Bulletin 277B.
416B American Air Filter Co.

Dust Control . . . . . Pangborn engineers help solve your dust problems—line of wet or dry dust collectors can save time, trouble & money. See how varied industries are benefited in "Out of the Realm of Dust."
311 *Pangborn Corp.

Evaporators & Preheaters, Milk.....Illustrated, 12 p. covers line of milk evaporators & milk preheaters. Feature numerous advantages — neat, compact, efficient, sanitary, reliable, etc. Request Bulletin No. D 141.
416C Henszey Co.

Grinding & Blending Systems.....Integrated system features savings in time and money in combined functions of grinding, blending and dust control. Results in greatly increased production. Illustrated Bulletin.
85 *Pulverizing Machy. Div.

Kilns, Rotary.....Efficient thermo-processing of products. Used in the production of lime, bauxite, cement, sodium silicate, alumina, etc. Complete data on design features offered in illustrated Bulletin 1115.
16b *Traylor Engrg. & Mfg. Co.

Mills, Grinding.....Mills applicable for wet or dry, coarse or fine grinding. Assure a uniform product of desired fineness. Improved design and construction features fully described. Illustrated Bulletin No. 8121.
16c *Traylor Engrg. & Mfg. Co.

* See explanation on p. 398

Mixers.....Company makes available Confidential Mixing Data Sheet. Helpful checklist enables you to develop a complete technical description of agitation required for your process, quickly & easily. No. B-107.
201a *Mixing Equipment Co.

Mixers.....Eastern's mixers are designed to meet the needs of today's chemical and industrial processes. Covers portable mixers, top and side entering mixers, turbine mixers, etc. in Catalog Series No. 26.
345a *Eastern Industries.

Mixers.....Describes Super Agitators & Mixers. Patented standpipe around propeller shaft assures positive agitation & circulation. Patented wearing plate prevents sand-up on shut-down. Bulletin No. A2-B4.
404a *Denver Equipment Co.

Mixers.....Data on turbine & slow speed heavy duty agitators . . . for open & closed tanks. Covers operation & applications of super-turbine & injection mixers, mixer data, mixer drive heads, etc. Bulletin No. 76.
153a *International Engrg.

Mixers.....Mix-Mullers for chemical and process industries. Covers Simpson mulling principle; mulling for dry, wetted and plastic mixtures; Mix-Mullers for special requirements; etc. 12 p. Bulletin No. 522.
281 *National Engrg. Co.

Mixers.....Company's line of Jumbo mixers meets every requirement imposed by heavy loads. Standard-duty mixer is equipped with two roller bearings mounted on heavy fabricated supports. Bulletin 800.
313 *J. H. Day Co.

Mixers.....Shear-Flow incorporates all desirable features for mixing textile colors. It not only mixes, but it disperses solid pigment colors in various clears or extenders. Offers full details on new mixer line.
417A Gabb Special Products Div.

Mixers, Centrifugal.....Describes Rheinhuette centrifugal mixers for thorough mixing of acids; caustics & salts; cellulose & paper-pulp masses of high concentrations (4-5%); chemicals; dyes. Bulletin RKM-10.
417B Neumann & Weaver.

Mixers, Dry Batch.....Efficient rotating drum-type machines for mixing various substances together into a homogeneous and inseparable whole, every part of which presents the same analysis. Fully illustrated.
211a *Sturtevant Mill Co.

Mixers, Pipeline.....Colorful new reference describes "American" Homomix continuous pipeline chemical mixer now available in a wider range of sizes and capacities from 1 gpm to 10,000 gpm. Request Bulletin No. 300.
417C American Well Wks.

Mixers, Portable.....Includes information on the numerous features and advantages, materials of construction, sizes and specifications, portable-permanent mountings, etc., in illustrated Bulletin 74-A.
153b *International Engrg.

Mixers, Portable.....Use in industry reduces costs, saves time, labor and secures better and more refined products. Catalog includes data on construction, dimensions, specifications, etc. 28 p. No. B-108.
201b *Mixing Equipment Co.

Mixers, Side Drive.....Presents 8 p. fully illustrated reference covering Nettco side drive with shut-off. Describes how the shut-off operates, numerous advantages, exclusive features, etc. Bulletin No. 532.
342 *New England Tank & Tower.

Mixers, Side Entering.....The Type "NU" side entrance mixer is a brand new unique mixer design. It has no cast parts and is of all welded construction, including the stuffing box. Illustrated Bulletin No. 72-A.
153c *International Engrg.

* See explanation on p. 398

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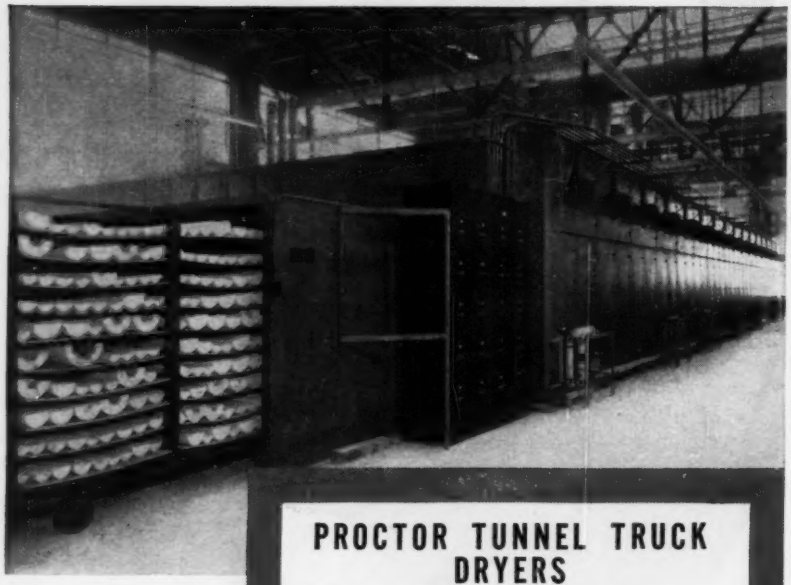

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- Continuous Conveyor Systems
- Spray Dryers

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LITERATURE . . .

Mixers, Steam-Water.....No. 1360 Series injects steam directly into the water, using every BTU of heat energy to bring water to a constant, predetermined temperature. Descriptive literature upon request.
78-9d *Fulton Sylphon Div.

Mixers, Top Entering.....Illustrated and detailed 32 p. Catalog includes advantages, typical installations, mechanical description, construction information, dimensions and selection tables, etc. Catalog No. B-102.
201c *Mixing Equipment Co.

Mixers, Top Entering.....Information on top entering propeller mixers. Includes data on selection, construction features, sizes & specifications of high & slow speed top entrance mixers, etc. Bulletin No. 73.
153d *International Engrg.

Mixers, Top Entering.....Makes available pertinent information on top-entering mixers (propeller type) . . . for closed tanks, pressure & vacuum . . . for open & loose-covered tanks. Data in Catalog B-103.
201d *Mixing Equipment Co.

Mixers, Water, Hot-Cold.....Descriptive literature on new hot-cold water mixers. No. 1350 Series Mixers give an accurate, controlled source of tempered water. Unaffected by variations in water pressure.
78-9e *Fulton Sylphon Div.

Processing, Air-Gas.....The Selas Liqui-Jector continuously removes water, water-oil emulsions and dirt particles from air, gas and steam. For complete information on features, request Bulletin No. SC-1007.
52b *Selas Corp. of America.

Processing Equipment . . . . . Describes corrosion-resistant processing equipment . . . precision built to your specific requirements to give long years of peak performance with low maintenance. Technical Bulletins.
305a *Lee Metal Products Co.

Screens, Vibrating.....For high-capacity screening of a broad range of materials—"CA" vibrating screens are your answer. In complete range of sizes to suit all plant capacity requirements. New Book 2554.
97 *Link-Belt Co.

Strainers, Fine Screen.....Yarway fine screen strainers are available in iron or steel with rust-resistant finish, also bronze, stainless steel and aluminum. Full data on features in Strainer Bulletin S-204.
81 *Yarnall-Waring Co.

Vape-Sorbers.....Continuously remove petroleum vapors, dirt & liquids from air & gases. Built to last—no moving parts—filters & chambers are easily cleaned & replaced. Complete details in Bulletin No. SC-1047.
52e *Selas Corp. of America.

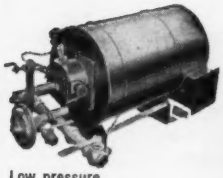
Washers, Log, Welded Steel.....Smooth running, highly efficient machines for removing tough clays, soft rock & other materials from iron & manganese ores, barytes, zinc, ochre, etc. Data in Bulletin WLO-1253.
318 *McLanahan-Stone Corp.

Pumps, Blowers, Compressors

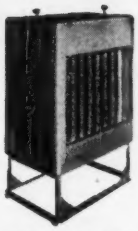
Compressors.....Reversible ring plate valves, force feed lubrication, sealing type piston rings, generous intercooler coils are features which make for efficiency and long-term economy. Descriptive Catalog.
314 *Norwalk Co.

Compressors.....Describes Allis-Chalmers two-stage sliding vane type compressors for shop air, gas handling, drilling, and numerous other applications. Includes features and operation. Bulletin No. 16B8244.
418A Allis-Chalmers Mfg. Co.

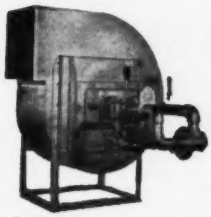
* See explanation on p. 398



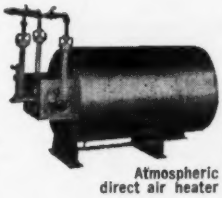
Low pressure direct air heater



Indirect air heater



Scroll type direct air heater



Atmospheric direct air heater

HOW TO SAVE WITH CONVECTION HEATING

Here's a sure way to save fuel and space wherever a chemical process requires convection type heating. Specify "Surface" air heaters and get these returns:

Save fuel with automatically correct gas-air ratios, rapid and uniform heating, maximum volume air flow. Use natural, manufactured, or LP gas.

Save installation costs with compact design and complete air heater assembly.

Single burner unit requires only one safeguard system for each air heater installation.

Build these savings into your convection heating equipment now. Call your "Surface" representative, or write for Literature Group H54-15.

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CORPORATION, TOLEDO 1, OHIO

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can be constant with MULTI-WASH

DUST, FUME AND VAPOR COLLECTOR

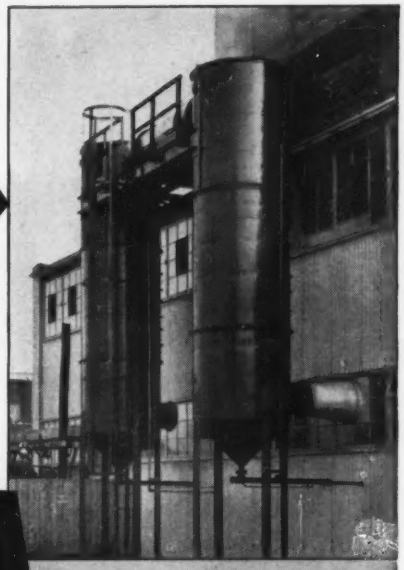
Processing of fine chemicals demands efficient control of air to keep contaminants out of the product and to maintain high quality and purity.

Effective dust control equipment prevents the contamination of one product from dust from other processes. Recirculation and reuse of water keep costs low.

Exacting product specifications are being met by the use of this twin Multi-Wash Collector installation shown at a leading pharmaceutical house.

Where the product is sublimed as one step in purification, the Multi-Wash Collector recovers valuable products that will pay for the installation many times over.

If you have a chemical dust, fume, vapor or odor problem be sure to call in a Schneible representative or call direct, collect.



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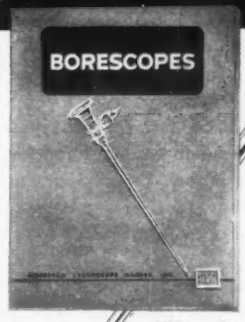

This comprehensive, elaborately illustrated booklet provides practical information on the use of the famous A. C. M. I. Borescope in various industries, for the inspection of interior areas or surfaces not otherwise visible—together with full data on the types of Borescope available, and on their care and maintenance. Have you received your copy?

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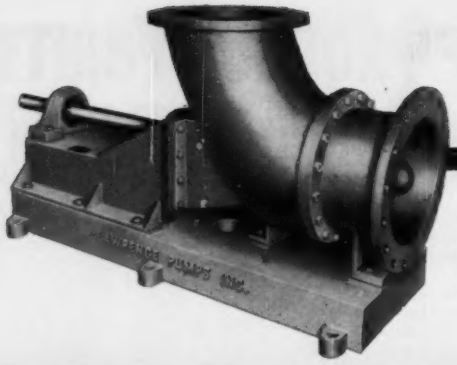
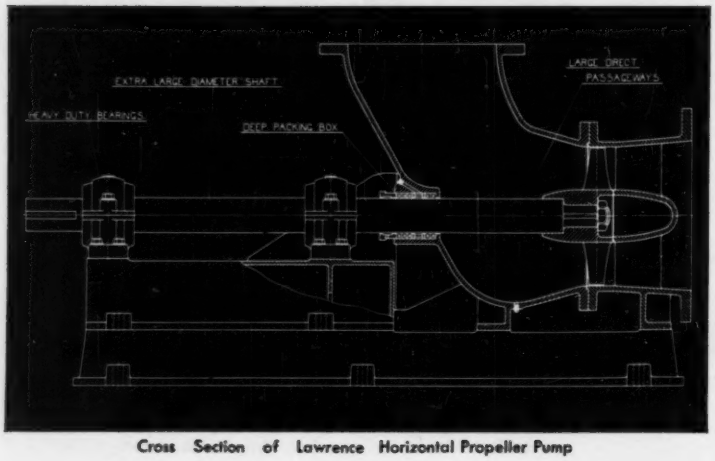


Lawrence 24" Horizontal Circulating Pump of Nickel Alloy Construction



Cross Section of Lawrence Horizontal Propeller Pump

PROPELLER PUMPS FOR THE CHEMICAL and PROCESS INDUSTRIES

Lawrence Propeller or Axial Flow Pumps are widely used to circulate large volumes of liquid or slurry against low heads as in evaporators, crystallizers, etc. This type of pump is particularly well adapted for circulating service because of its simplicity, high efficiency, and low first cost. The flow can be arranged in either direction and the casing turned to any position desired to serve as an elbow. The capacity can be closely regulated by varying the speed—very important in crystallization processes where a uniform velocity must be maintained.

Lawrence Propeller Pumps are made of the metals and alloys best suited for their ability to resist the corrosive and abrasive action of the liquid pumped.

Write for Bulletin 203-6 for summary of acid and chemical pump data.

LAWRENCE PUMPS INC.

371 MARKET STREET, LAWRENCE, MASS.

LITERATURE . . .

→ Want more information on any of these items? Just circle its code number on the postcard inside the back cover, then mail to us. It's that easy now.

Compressors.....Describes Model 20T compressor equipped with Ingersoll-Rand Channel Valve. This air-cooled 20 hp compressor may be either direct-connected or belt-driven. Request fully illustrated Form No. 1540.
420A Ingersoll-Rand Co.

Compressors.....Valuable information on Pennsylvania Oilfreair and Oilfregas compressors...guaranteed to compress entirely free of any trace of oil or oily vapors. Request illustrated Bulletins 604 and 605.
420B Pa. Pump & Compressor Co.

Compressors, Oil-Free.....Offer space-saving design, excellent service, economical operation, etc. Company builds regular and oil-free compressors to meet any capacity and pressure need. Bulletin No. A-44.
8 *Joy Mfg. Co.

Fans....."Buffalo" Type BL Limit-Load Ventilating Fan offers the finest features—for quiet, stable, efficient performance in industrial service. Further details in Bulletin F-102, your copy on request.
56 *Buffalo Forge Co.

Fans.....Exceptional fan equipment for industrial air & material handling features: high efficiency; rugged, tight construction; 3 interchangeable wheels—each with radial blades; etc. Illustrated Bulletin 702.
158 *Clarage Fan Co.

Fans.....Exhaust hot, corrosive & explosive fumes the direct way, with no directional change in air stream to cause pressure losses. Bulletin DB-4-52 & "Design Data for Exhaust Systems" sent upon request.
207 *American Mach. & Metals

Fans & Boosters.....Describes line of stack fans & duct boosters. Includes information regarding advantages, applications, details of construction, dimensions, capacities, etc. in 16 p. illustrated Bulletin No. 109-A.
153e *International Engrg.

Fans, Centrifugal.....Fully illustrated, 32 p. furnishes valuable information on General backward-blade centrifugal fans. Covers installations, design and construction, engineering data, etc. Bulletin No. BB-102.
420C General Blower Co.

Pumps.....Handle most anything that can pass thru a pipe, from free-flowing liquids to non-pourable pastes—even materials containing relatively large particles or abrasives. Moyno Pump Bulletin No. 30CP.
348 *Robbins & Myers.

Pumps, Acid.....Mighty midget for pumping acids. Jabsco neoprene-impeller pump made of Ace hard rubber outlasts, out-pumps anything in its pressure, size and price class. Full details in Bulletin No. 97.
390b *American Hard Rubber Co.

Pumps, Acid.....On most difficult pumping jobs . . . dependable, highly efficient pumps deliver continuous, trouble-free performance on 'round-the-clock schedules wherever they are installed. Full details.
73 *A. R. Wilfley & Sons.

Pumps, Centrifugal.....Describes new line of light-weight centrifugal pumps. Capacities range from 5,500 gph for the junior flyweight to 18,000 gph for a senior model. Features and illustrations in Bulletin No. 55LW.
420D Rice Pump & Mach. Co.

* See explanation on p. 398

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Every kind in stock

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Principal Products: Stainless Steel, Alloys, Carbon Steel . . . Bars, Structurals, Plates, Sheets, Tubing . . . Also Plastic Pipe, Machinery and Tools, etc.

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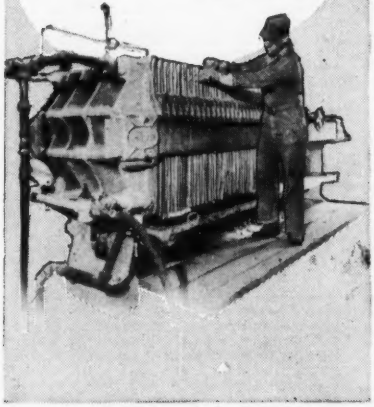

- You can recover solids or clarify at any desired pressure and temperature.
- Use any filter media and filter aids.
- Filter cake can be thoroughly washed and extracted.
- Uniform cake of any desired thickness easily removable.
- Unfiltered residue can easily be blown out, dried, redissolved or melted in the press.

Catalog 55 presents the economy advantages of Shriver Filter Presses. Write for a copy.

T. SHRIVER & COMPANY, Inc.

Filter Presses • Filter Media • Diaphragm Pumps

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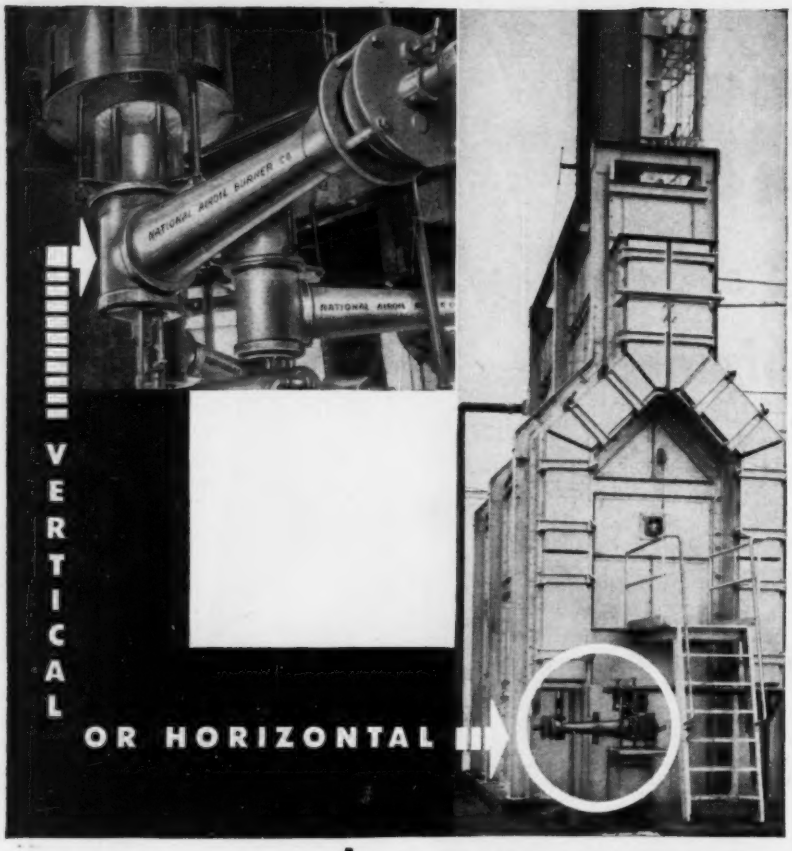

many more hours on stream without forced shutdown with NATIONAL AIROIL

OIL-GAS TANDEM COMBUSTION UNITS

Exclusively for vertical firing, the new National Airoil VERTICAL Tandem Block Units retain all the features of our regular horizontal Tandem Units . . . *plus:* special, pre-cast refractory shapes for easier, cost-saving vertical installation and maintenance; secondary air inlet louvres for positive control of vertical flame pattern; and, all steel duplex detaching gear which enables swift, simple vertical burner changeover.

VERTICAL and HORIZONTAL Tandem Units hold air in the combustion zone until fuel and heated air are thoroughly mixed. This means that ignition takes place in a hot zone; the result: high fuel economy through more rapid combustion with a minimum of excess air. NATIONAL AIROIL's patented Tandem Combustion Units allow secondary air to be easily and accurately controlled. By adjusting air control louvres, flame can be shaped to radiate heat uniformly without tube impingement.

The VERTICAL or HORIZONTAL Tandem Unit is always fired with NATIONAL AIROIL Combination Oil and Gas Burners . . . has a high turndown ratio with a steady flame temperature using either fuel oil or gas. With the TANDEM UNIT'S clean flame, a cold furnace can be brought to full capacity in a short time.

"Many, many more hours on stream, without shutdown" . . . yes, YOU will realize higher profits from YOUR heaters when NATIONAL AIROIL VERTICAL or HORIZONTAL Tandem Units are specified. Our new Bulletin 498 is yours for the asking.

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INDUSTRIAL OIL BURNERS, GAS BURNERS, FURNACE EQUIPMENT

LITERATURE . . .

Pumps, Centrifugal . . . . . Impervious graphite pumps feature mechanical seal with enclosed coolant, rugged type SN armored connections, interchangeable parts, wide capacity range, etc. Catalog Section S-7250.
227a *National Carbon Co.

Pumps, Centrifugal.....Built to handle high static heads—feature single-stage, double-suction centrifugal design. Includes the numerous features, specifications, performance tables, etc. in Bulletin No. 350-5.
422A American-Marsh Pumps.

Pumps, Centrifugal.....Describes new line of centrifugal pumps designed especially for handling corrosive liquids and slurries. Complete information, including performance data, found in Bulletin No. 725.4.
347 *Goulds Pumps

Pumps, Centrifugal.....Original manufacturer of self-priming centrifugal pump offers data on new Type CG LaBour—operates under positive or negative suction lift conditions as required. Request Bulletin G-1.
235 *LaBour Co.

Pumps, Controlled Volume.....New reference—prepared with assistance of leading water treating consulting firms—describes how pumps are used in typical industrial water treating systems. 24 p. Bulletin No. 953.
422B Milton Roy Co.

Pumps, Double Suction.....Rugged double suction pumps assure long life and low maintenance. Feature heavy-duty construction, wide material choice, unit responsibility, etc. Offers details in Bulletin No. 08B6146.
95 *Allis-Chalmers Mfg. Co.

Pumps, Liquid.....Pump viscous fluids efficiently and economically . . . and serve as combined meter and pump due to their unusually high volumetric efficiency. Describes the entire line in Bulletin No. L51.
393 *Kinney Mfg. Div.

Pumps, Process.....De Laval CPO process pumps handle numerous liquids; salt brine; sea water; caustic solution; soap solutions; etc. Capacities to 2000 gpm—heads to 200 ft. Details in Bulletin No. 1125-B.
46 *De Laval Steam Turbine Co.

Pumps, Sealless.....Combining motor & pump in a single unit, Chempump is most significant advance in pump design in half a century. Hard-to-handle fluids can't leak or become contaminated. 16 p. Bulletin 1010.
88-9 *Chempump Corp.

Pumps, Sump . . . . . Handle corrosive liquids for years without trouble. Available in sizes from 1 to 10-inch discharge with capacities ranging up to 3,000 gpm and heads up to 140 feet. Data in illustrated Bulletin 4600-A.
316 *Deming Co.

Ventilating Units.....Feature wide range, low cost handling of variety of ventilating & industrial applications requiring low & medium ranges of air capacities at quiet-efficient operation. 20 p. Bulletin UVS 103.
422C General Blower Co.

Services, Processes, Misc.

Accident Prevention Signs.....Company has assembled over 2,200 of its stock metal signs and safety tags for illustration in its new 48 p. catalog. Signs illustrated in actual colors in which they are available.
422D Ready Made Sign Co.

Brine-Making Process.....Presents a 32 p. fully illustrated reference, "Brine for Today's Industry," which covers the Lixate Process...a revolutionary system for marking and handling better brine at lower costs.
422E International Salt Co.

* See explanation on p. 398

Chempro's new Style FM-4 bearings, bushings, washers, etc., have given remarkable service in pumps, mixers and reactors operating under highly corrosive conditions. Made of Teflon,* glass, graphite and an inert lubricant, Style FM-4 bearings and bushings are hard, corrosive-resistant, have a low coefficient of friction, and compare favorably in wearability with those made of metal.

FOR EXAMPLE:

If other bearing materials on your pumps have failed due to corrosion...use **FM-4.**

If the shaft bearings on your mixers and reactors must be compatible with the product ...use **FM-4.**

Also available in rod, tube and cylindrical shapes in a wide range of sizes and wall thicknesses. Our engineers will be glad to assist you in developing the product to meet your specific needs.

Write for Bulletin CP554.

THE ORIGINAL FABRICATORS OF TEFLON PACKINGS AND GASKETS

*duPont Trademark

CHEMICAL & POWER PRODUCTS, Inc.

Cathodic Protection.....Anaconda Type CP cable and cathodic protection cut corrosion costs—gas mains and water pipes — lead-covered cable — underground storage tanks—etc. Details in Bulletin DM 5450.
19 *Anaconda Wire & Cable Co.

Electrolytic Regeneration of Spent Pickling Solutions.....Reprint presents results of a laboratory investigation of a proposed process for electrolytic regeneration of spent sulfate pickling solutions.
423A Mellon Institute.

Flotation.....More large plants are installing "Sub-A's" for entire flotation job, because they give maximum recovery at a low cost per ton. Dependable, simplified continuous operation. Bulletin No. F10-B81.
404g *Denver Equipment Co.

Laboratory Equipment & Furniture..... Line of sectional units designed for interchangeability & flexibility assures a synchronized installation which will produce peak laboratory efficiency. 180 p. Catalog.
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* See explanation on p. 398

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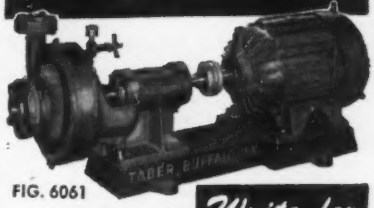

FIG. 6061

Fig. 19,488

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Admiral Tool & Mfg. Co. 373
Air Preheater Corp. 209
Airetool Mfg. Co. 392
Allegheny Ludlum Steel Corp. .. 276
Allied Chemical & Dye Corp.
General Chemical Div. 109
Allis-Chalmers Mfg. Co
General Machinery Div. ..39, 76
95, 223, 287
Alloy Fabricators Div. of Continental Copper Industries Inc. . 411
Alsop Engineering Corp. 325
Aluminum Company of America
Electrical Industry Div. 58
Amercoat Corp. 231
American Blower Corp. 98
American Brass Co., The 270
American Cyanamid Co. 20-21
American Cystoscope Makers ... 419
American Flange & Mfg. Co. ... 337
American Hard Rubber Co. .390, 391
American Instrument Co. 370
American Machine & Metals Inc.
DeBothezat Div. 207
Niagara Filter Div. 203
Tolhurst Div. 205
American Metal Hose Branch
The American Brass Co. 283
American Optical Co. 352
American Platinum Works, The 312
American Wheelabrator & Equipment Corp. 354
Ampco Metals Inc. 430
Anaconda Wire & Cable Co. ... 19
Armstrong Cork Co. 284
Armstrong Machine Works 268
Atlantic Metal Hose Co., Inc. .. 26
Atlas Powder Co.
Darco Dept. 93
Autoclave Engineers, Inc. 350
Automatic Switch Co. 335
Avondale Marine Ways Inc.
Service Foundry Div. 427

Babbitt Steam Specialty Co. 372
Babcock & Wilcox Co.
Process Equipment Dept. .138-139
Tube Div. 28-29
Badger Mfg. Co. 322
Bailey Meter Co. 74
Baker & Adamson Products,
General Chem. Div., Allied
Chemical & Dye Corp. 149
Baker-Perkins, Inc. 157
Baldwin-Hill Co. 327
Barco Mfg. Co. 300
Bemis Bro. Bag Co. 310
Bethlehem Steel Co. 47
B.I.F. Industries, Inc.
Builders Providence, Inc. 137
Omega Machine Co. 331
Bird Machine Co. 11
Black, Sivalls & Bryson, Inc.
Climax Controls Div. 99
Blaw-Knox Co.
Buflovak Div. 217
Boardman Co., The 306
Bridgeport Brass Co. 96
Brookfield Engineering Labs. Inc. 413
Brown Fintube Co. 241
Brown & Root, Inc. 117
Buell Engineering Co. 150
Buffalo Forge Co. 56
Buffalo Pumps Inc. 389
Builders Providence, Inc. 137

Calumet & Hecla, Inc.
Wolverine Tube Div. 69-70
Cambridge Wire Cloth Co. 324
Carbide & Carbon Chemicals Co.
Div. of Union Carbide & Carbon Corp. 143
Cardox Corp. 415
Carey Co., Phillip 43
Carlson Inc., G. O. 80
Carrier Conveyor Corp. 77
Ceilcote Co., The 408
Celanese Corporation of America 263
Century Electric Co. 221
Chapman Valve Co. 282
Chase Brass & Copper Co. 101
Chemical Construction Corp. A
Unit of American Cyanamid
Co. 329
Chemical & Industrial Corp., The 259
Chemical Industries Exposition. 425
Chemical & Power Products Inc. 323
Chempump Corp. 88-89
Chemsteel Construction Co. Inc. 374
Chicago Bridge & Iron Co. 129
Chiksan Co. 265
Clarage Fan Co. 158
Clark Equipment Co. 53
Cleaver-Brooks Co. 261
Cochrane Corp. 368
Colorado Fuel & Iron Corp.
Wickwire Spencer Steel Div. 266-267
Combustion Engineering Inc.
Raymond Pulverizer Div. 294
Commercial Solvents Corp. 145
Consolidated Engineering Corp. 317
Continental Copper & Steel
Industries, Inc.
Alloy Fabricator Div. 411
Coppus Engineering Corp. 75
Corning Glass Works. 361
Cowles Chemical Co. 411
Crane Co. 293
Crane Packing Co. 307
Crucible Steel Co. of America
Stainless Steel Div. 49

Darco Dept., Atlas Powder Co. .. 93
Darling Valve & Mfg. Co. 320
Davenport Machine & Foundry
Co. 321
Day Co., J. H. 313
DeLaval Steam Turbine Co. 46
Deming Co., The 316
Dempster Bros., Inc. 64-65
Denver Equipment Co. 404
Dings Magnetic Separator Co. .. 50
Dorr-Oliver, Inc. 106-107
Dow Corning Corp. 409
Dowell Inc. 87
Dowingtown Iron Works, Inc. .. 72
Duraloy Co. 417
Durametallic Corp. 319
Duriron Co. 229

Eagle Picher Co. 42
Eastern Industries, Inc. 345

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Eastman Kodak Co.
Industrial Photographic Div... 61
Edward Valves Inc..... 394
Eimco Corp., The..... 247
Electric Autolite Co..... 325
Enjay Co., Inc..... 243
Eriez Mfg. Co..... 71
Esso Standard Oil Co..... 269

Firestone Plastics Co..... 15
Fisher-Governor Co..... 123
Flakice Corp. 374
Fletcher Works 373
Flexitallic Gasket Co..... 292
Flexonics Corp. 403
Fluor Corp. 362
Foram Corp. 409
Foster Wheeler Corp..... 133
Foxboro Co. 44-45
Frick Co., Inc. 412
Fuller Co., The 48

General American Transp. Corp.
Tank Car Div..... 215
General Chemical Div. Allied
Chemical & Dye Corp..... 109
General Electric Co.....62-63, 365
Gerotor May Corp..... 396
Girdler Co. .....2nd Cover, 304
Glycerine Producers' Assoc..... 339
Goodrich Co., B. F. (Geon)... 12
Goslin-Birmingham Mfg. Co.... 94
Goulds Pumps 347
Great Lakes Carbon Corp.
Dicalite Div. 360
Grinnell Co., Inc..... 18
Gustin Bacon Mfg. Co..... 273
Gutehoffnungschutte (Foram
Corp.) 409

Hardinge Co. 397
Harshaw Chemical Co., The.... 38
Haveg Corp. 84
Henszey Co. 321
Hercules Powder Co..... 272
Hills-McCanna Co. 426
Hooker Electrochemical Co..... 152

Illinois Testing Labs., Inc..... 421
Independent Engineering Co.... 370
Industrial Filter & Pump Mfg. Co. 371
Ingersoll-Rand Co. 151, 297
International Engineering Co... 153
International Nickel Co..... 366

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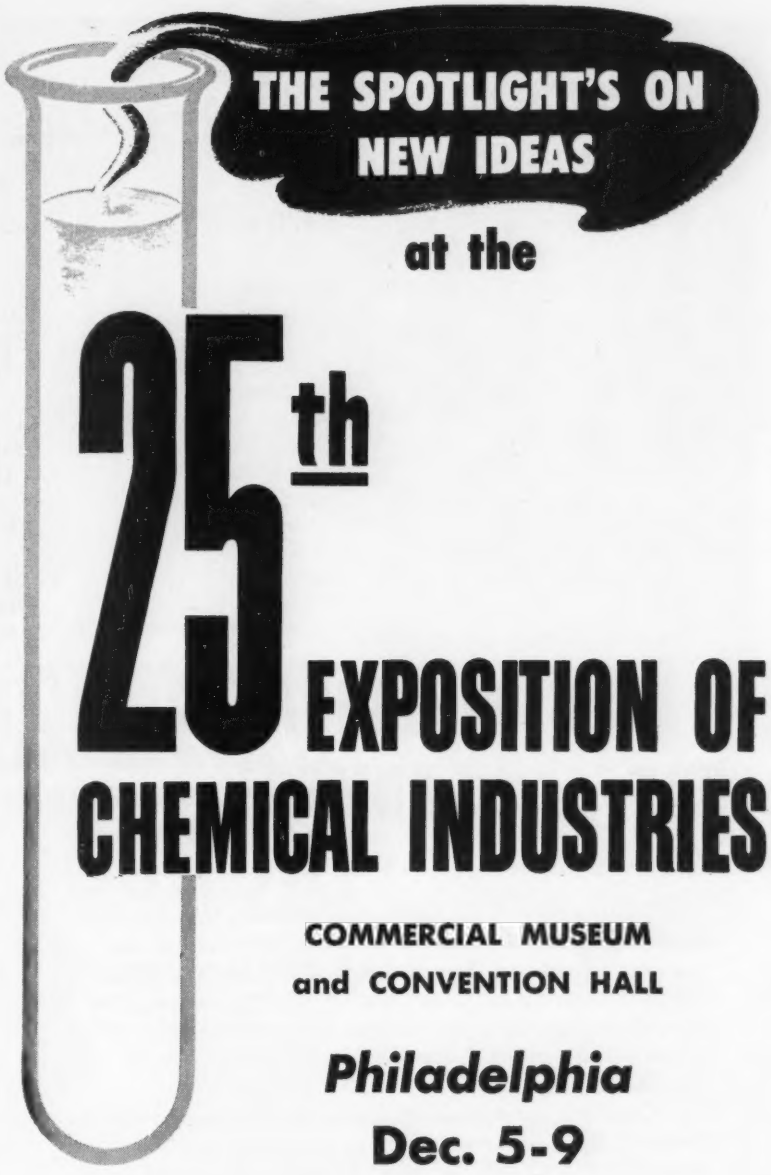

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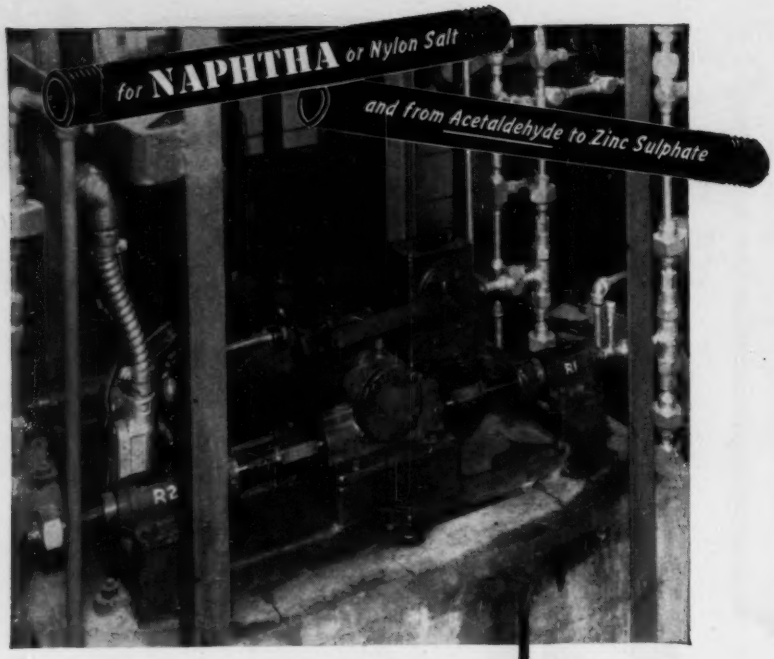

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Jerguson Gage & Valve Co. 325
Johns Manville Corp.
Celite Filter Aids Div. 141
Gaskets Div. 328
Joy Mfg. Co. 8, 14

Kellogg Co., The M. W.
Fabricated Products Div. 54-55
Kel-F 147
Kemp Co., C. M. 239
Kidde & Co., Inc., Walter 296
Kieley & Mueller Inc. 349
Kinney Mfg. Co. 393
Kirk & Blum Mfg. Co., The 406
Klinger Limited, Richard 237
Knight, Maurice A. 410
Koppers Co., Inc.
Engineering & Construction
Div. 332
Koven & Bros. Inc., L. O. 357

LaBour Co., Inc., The 235
Lapp Insulator Co.
Porcelain Process Div. 271
Lawrence Pumps Inc. 420
Layne & Bowler, Inc. 219
Lee Metal Products Co. 305
Leeds & Northrup Co. 68
Link Belt Co. 13, 60, 97
Liquidometer Corp., The 374
Litton Engineering Laboratories 373
Lukens Steel Co., Clad Steels . . 156
Lummus Co. 115

Manning, Maxwell & Moore, Inc. 330
Manton-Gaulin Mfg. Co. 334
Manzel Division, Houdaille-
Hershey Corp. 407
Marley Co., The 9
Master Electric Co., The . . 3rd Cover
McGraw-Hill Book Co. 411
McLanahan-Stone Corp. 318
McNally-Pittsburg Mfg. Co. . . . 416
Merrick Scale Mfg. Co. 374
Metalab Equipment Corp. 370
Metals Disintegrating Co., Inc.
Pulverizing Machinery Div. . . . 85
Metalweld Inc. 374
Midwest Piping Co., Inc. 343
Miller & Son, Franklin P. 319
Minneapolis Honeywell Regulator
Co. Industrial Div. 160-161
Mixing Equipment Co. 201
Monarch Mfg. Co. 323
Monsanto Chemical Co. 32-33
Murray Mfg. Co., D. J. 86

Nash Engineering Co. 34
National Airoil Burner Co. 422

National Aluminate Corp..... 326
National Carbon Co....227, 252-253
National Engineering Co..... 281
National Lead Co..... 125
New England Tank & Tower Co. 342
Newport News Shipbuilding and Dry Dock Co..... 67
Niagara Alkali Co..... 57
Nicholson & Co., W. H..... 83
Nooter Corp. 119
Norton Co. 91
Norwalk Co. 314

Oldbury Electro Chemical Co... 323
Omega Machine Co., Div. of B. I. F. Industries, Inc..... 331
OPW Corp. 22
Oronite Chemical Co..... 127
Owens Corning Fibreglas Corp.. 344

Pangborn Corp., Dust Control.. 311
Patterson Foundry & Machine Co. 131
Patterson Kelley Co., Inc..... 105
Peerless Mfg. Co..... 308
Pennsylvania Flexible Metallic Tubing Co., Inc..... 92
Perkin-Elmer Corp., The..... 257
Permutit Co. 245
Pfaudler Co. .....Back Cover
Pfizer & Co., Charles..... 363
Phelps Dodge Corp.....212-213
Phillips & Co., H. A. 372
Pittsburgh Lectrodryer Corp.... 264
Platecoil Div., Tranter Mfg. Co.. 30
Pneumatic Scale Corp..... 371
Powell Valves, Wm. Powell Co. 249
Powers Regulator Co..... 355
Prater Pulverizer Co..... 429
Procon, Inc. 37
Proctor & Schwartz, Inc..... 418
Pulverizing Machinery Div. of Metals Disintegrating Co. Inc. 85

Quakesr Oats Co..... 298

Read Standard Corp.
Bakery-Chemical Div. 309
Blower-Stoker Div. 303
Rem-Cru Titanium, Inc..... 338
Republic Flow Meters Co..... 100
Republic Steel Corp.
Steel & Tubes Div.....24-25
Revere Copper & Brass Inc..... 255
Reynolds Metals Co..... 341
Robbins & Myers, Inc. Pump Div. 348
Robertshaw-Fulton Controls Co.
Fulton Sylphon Div.....78-79
Rodney Hunt Machine Co..... 277
Roots-Connersville Blower Corp. 402
Ryerson & Sons, Inc., J. T..... 421

St. Louis-San Francisco Railway. 17
Saran Lined Pipe Co..... 90

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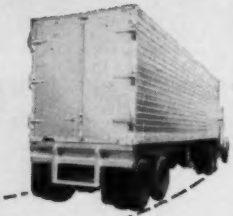

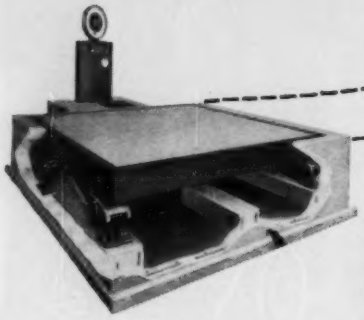

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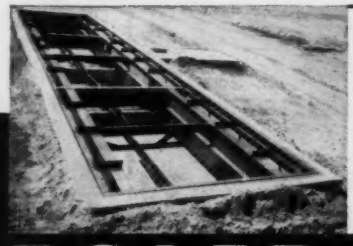

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ADVERTISERS . . .

Schneible Co., Claude B.	419
Selas Corp. of America	52
Servel, Inc.	359
Sharples Corp.	121
Shell Chemical Corp.	111
Shippers' Car Line Corp.	51
Shriver & Co. T.	421
S. Morgan Smith Co.	401
Smith Co., A. O. Glascote Div.	41
Sparkler Mfg. Co.	340
Spray Engineering Co.	319
Sprout & Waldron & Co., Inc.	351
Standard Oil Co. (Indiana)	367
Stephens Adamson Mfg. Co.	280
Stokes Machine Co., F. J.	155
Strahman Valves, Inc.	323
Sturtevant Mill Co.	211
Surface Combustion Corp. Heat Treatment	419
Kathabar Div.	40
Swenson Evaporator Div., Whiting Corp.	6-7
Taber Pump Co.	423
Tank Car Div., General American Transp. Corp.	215
Tennessee Corp.	321
Texas Gulf Sulphur Co.	364
Thermal Research & Engrg. Corp.	414
Thermo Electric Co., Inc.	395
Toledo Scale Co.	428
Trabon Engineering Corp.	135
Tractomotive Corp.	251
Trane Co., The	278
Traylor Engineering & Mfg. Co.	16
Tube Turns A Div. of National Cylinder Gas Co.	358A-358B
Turner & Haws Engineering Co.	372
Uehling Instrument Co.	374
Union Asbestos & Rubber Co.	82
U. S. Electrical Motors, Inc.	333
U. S. Gasket Co.	299, 315
U. S. Industrial Chemical Corp.	35-36
U. S. Rubber Co. Mechanical Goods	27, 346
U. S. Steel Corp. U. S. Steel Products Div.	31
Stainless Div.	224-225

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U. S. Stoneware Co., The..... 102

Virginia Smelting Co..... 66
Vogt Machine Co., Henry..... 162

Wagner Electric Corp..... 154
Wallace & Tiernan Co., Inc..... 399
Walworth Co., The..... 356
Watson-Stillman Fittings Div. of H. K. Porter Co., Inc..... 285
Warren Steam Pump Co..... 405
Wedgeplug Valve Co..... 353
Welding Fittings Corp..... 10
West End Chemical Co..... 159
Western Supply Co..... 358
Westinghouse Electric Corp..232-233
Weston Electrical Instrument Co. 336
Whitlock Mfg. Co..... 302
Wilfley & Sons, Inc. A. R..... 73
Williams & Co., Inc., C. K..... 301
Williams Patent Crusher & Pulverizer Co. 59

Yarnall Waring Co..... 81
Youngstown Welding & Engrg. Co. 286

PROFESSIONAL SERVICES 375

CLASSIFIED ADVERTISING
F. J. Eberle, Ass't Mgr.

EMPLOYMENT OPPORTUNITIES.376-378

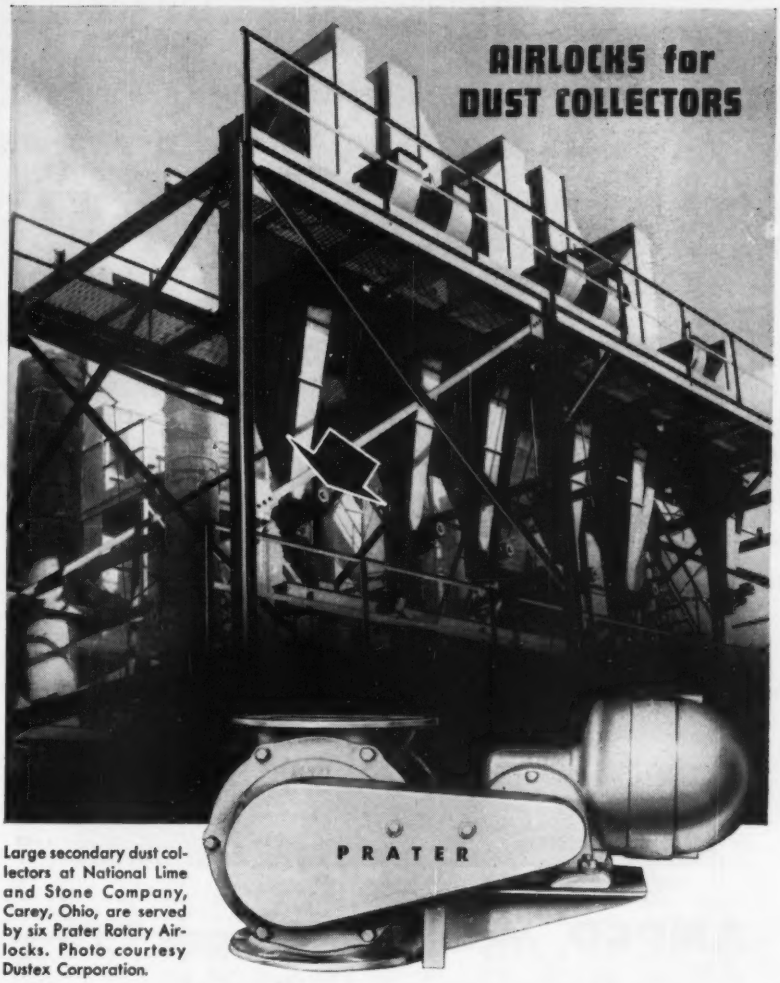
SPECIAL SERVICES 378

EQUIPMENT
(Used or Surplus New)
For Sale 378-386

WANTED
Equipment 378
Miscellaneous 378

ADVERTISERS INDEX
Aaron Equipment Co..... 386
American Air Compressor Corp..... 380
American Maize-Products Co..... 384
Anchor Supply Co..... 382
Arro Equipment Co..... 378
Barcan Co., Irving..... 384
Bernstein Bros., Inc..... 383
Best Equipment Co..... 384
Brill Equipment Co.....379, 386
Chemical & Process Machinery Co..... 384
Chemical Service Corp..... 378
Consolidated Products Co., Inc..... 382
Darien 382
Equipment Clearing House Inc..... 382
First Machinery Corp..... 383
Gelb & Sons Inc..... 385
General Traders Inc..... 378
Heat & Power Co., Inc..... 383
Kehoe Machinery Corp..... 380
Lawler Co. 380
Lilly & Co., Eli..... 384
Loeb Equipment Supply Co..... 382
Loeb & Son, H..... 380
Luria Brothers 386
Luria Steel & Trading Corp..... 384
Machinery & Equipment Corp.....382, 386
Meyer & Son Inc., Wm. W..... 386
Newman Tallow & Soap Machy. Co..... 380
Perry Equipment Corp..... 381
Process Plants Service Inc..... 384
Stanhope, L. M..... 382
Stein Equipment Co..... 386
Truland Chemical & Eng. Co..... 378
Union Standard Equipment..... 380
Washington Gas Light Co..... 378
Weinstein Co. 378

EMPLOYMENT OPPORTUNITIES
Arabian American Oil Co..... 376
Drake Personnel Inc..... 376
DuPont de Nemours & Co., E. I..... 377
O'Shea Employment System..... 376
Selective Placement Employment Agy. 376
Standard Oil Co..... 376
Wyandotte Chemical Corp..... 378



Large secondary dust collectors at National Lime and Stone Company, Carey, Ohio, are served by six Prater Rotary Airlocks. Photo courtesy Dustex Corporation.

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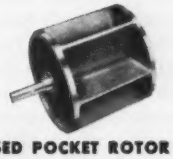

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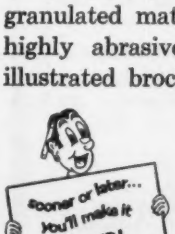

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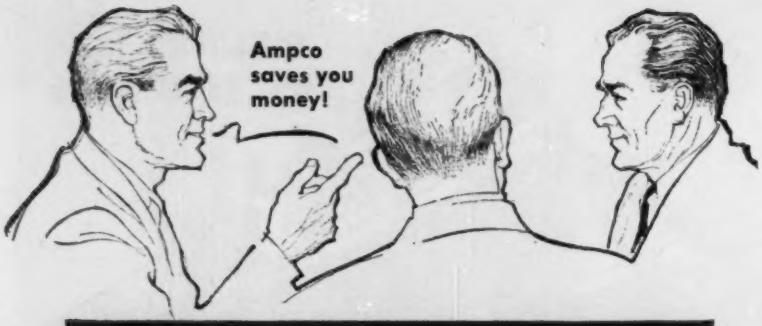

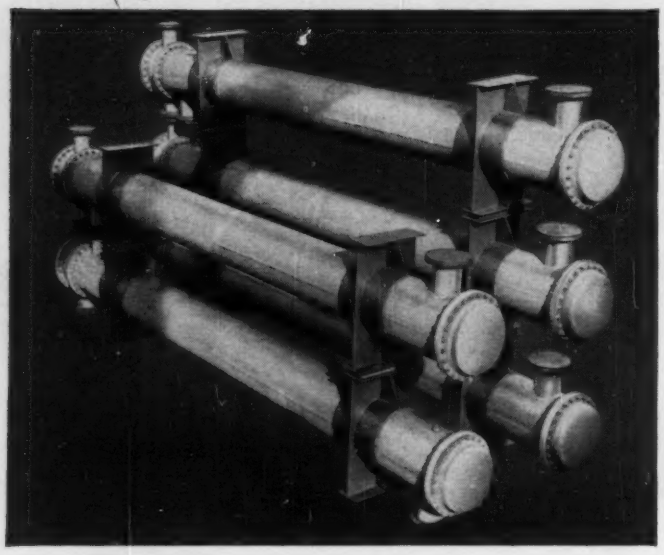

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Chementator 103

What's Happening in Chemical Engineering
- Bio-Oxidation of Wastes 112
- Tower Design 116
- Synthetic Liquid Fuels 120
- Direct Ammonium Sulfate 124
- Employing Electronic Control 128
- Nuclear Energy for Processes 132

Chemicals & Raw Materials
- Fatty Alcohol 140
- Index 144

Feature Report
- Solids Concentration 163

Feature Articles
- Economics of Shipping Large Units 178
- Replacement Analysis by Capitalized Costs 181
- Cost of Installing Centrifugal Pumps .. 189
- How to Design Effective Experiments. 191

CE Refresher
- Why Kinetics for Reactor Design?... 199

Plant Notebook
- Sampler for Gases at High Pressure .. 202
- Chart Finds Air-Film Coefficients 204
- Welding Repair to Process Vessel... 206
- Boiling Out Stills... 208
- Compression-Expansion Chart for Gases 208
- Measuring Flows by Method of Mixtures 210

You and Your Job
- Are You Ready for Professional Registration? 214
- Engineer Shortage: True or False... 222

Corrosion Forum
- Needed Painting Specifications Now.. 226
- New Process Produces Crack-Free Chromium 230

Equipment News
- Improves Gas-Liquid Contact 234
- Index to this Month's new Equipment.. 238
- Floating Screen Traps Vapor 240
- Equipment Cost Index 246

Chemical Economics
- More Record Years. 254
- Optimism Lights Paper 258

Pictured Flowsheet
- Fluidized Bed in Sulfuric Acid Plants. 288

Other Departments
- Advertisers Index .. 424
- Book Reviews 306
- Convention Calendar 118
- Firms in the News...314
- Man of the Month. 295
- Names in the News. 296
- New Technical Literature 400
- Reader Service 387
- Recent Pamphlets.. 310

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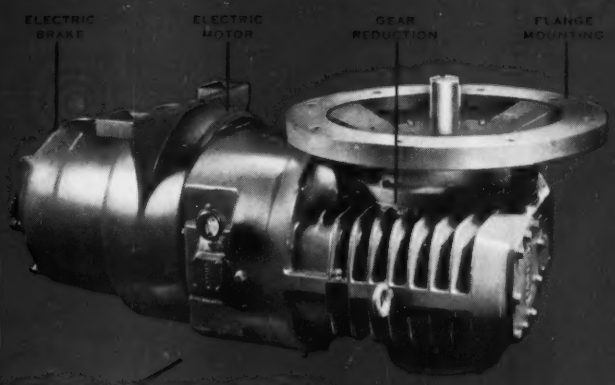

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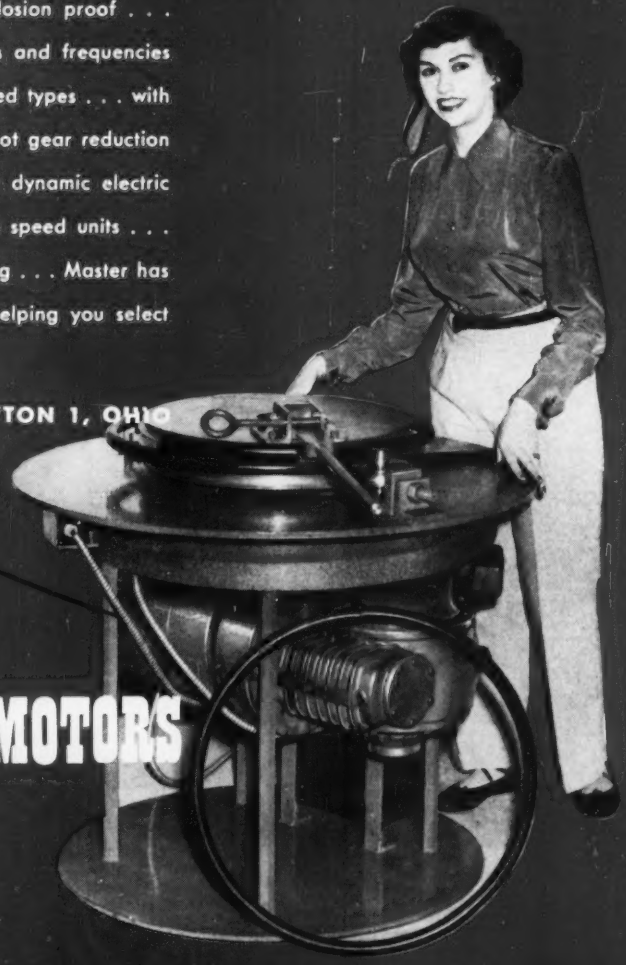

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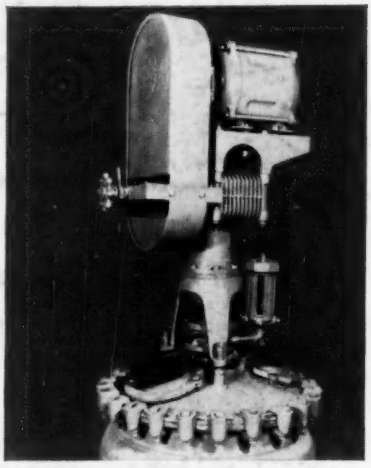
As a result of this practice, gears in the standard Pfaudler PW drive are rated to carry up to 3.6 H.P. at 175 RPM, well beyond the capacities normally required in small reactors.

You'll also find it easier to get at the top head, to connect supply lines, because the PW drive is smaller and the motor is mounted above instead of alongside the drive. Part of the over-all space saving is in the smaller gear housing, another result of throated gear construction.



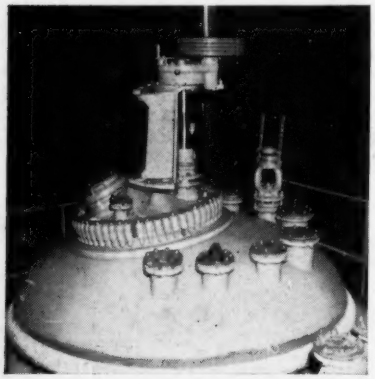
For laboratories and pilot plants, new PW drive is supported high and out of the way, providing better access to top of reactor.

Still another advantage is the extra quietness of this new drive. Because the gear teeth make contact over an increased area, you get accurate meshing, without distortion.

For more data about this versatile new drive, available on Pfaudler glassed steel, stainless steel or alloy reactors up to 100 gallons, write for Bulletin 923.

Huge reactor sets new record in size

This is a 3,700-gallon glassed steel reactor, built for use as a polymerizer in a Ludwigshafen, Germany, polyvinyl chloride plant.

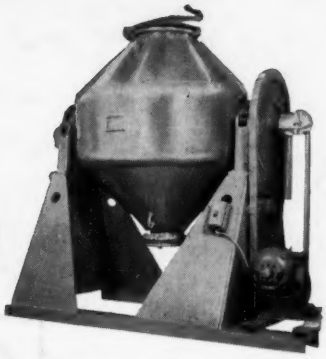


Designed to take internal pressure up to 225 psi, it stands 17'4" high and is the largest high-pressure vessel of this type built by Pfaudler—too large, in fact, to be fabricated in Europe!

It was built at Rochester, N. Y., using the corrosion resistance of glass plus the working strength of steel. This eliminated the extra expense of heavy alloy construction (the top head is 1⅞" thick), and provided the required protection against metallic contamination and adherence of the product.

Dual rotary seals and extra-rigid Pfaudler VRLH drive were included as measures to maintain sealing under high pressures.

Perhaps you have a similar problem that can be solved by the surprisingly versatile resources at Pfaudler. Write us about it.



Confidential tests, using your own product, will be conducted to get data on performance in this dryer-blender.

Test your product free in Pfaudler dryer-blender!

You can now get valuable information on the drying and blending of *your* specific product in Pfaudler's glassed steel conical dryer-blender.

A test unit has been made available in the Pfaudler laboratory, for conducting sample runs of products sent in by chemical processors. Free of charge, a product will be tested and a full report made to you or your observers as to the drying results of various processing conditions.

Such test data may be infinitely useful to you in deciding to improve your drying operations. In actual full-scale operation, these glassed steel dryer-blenders have performed in 7 hours, an amount of work formerly requiring 4 days.

Write for further details on our dryer-blender laboratory tests.

CAN YOU USE A GUARANTEE AGAINST CORROSION?

An actual 12-month guarantee against corrosion is now being supplied with Pfaudler acid-alkali-resistant glassed steel processing equipment for certain applications. This guarantee provides for free on-the-spot repairs, or F.O.B. factory repairs to the vessel if it is rendered inoperable by corrosion during its first year after delivery.

To learn more about the conditions for which this unique guarantee is offered, and to get help with your particular corrosion problem, write to: Dept. CE8D, The Pfaudler Co., Rochester 3, N. Y.

Pfaudler

THE PFAUDLER CO., ROCHESTER 3, N. Y.